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THE

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ELECTROLYSIS OF GAS AND WATER PIPES.

As we have indicated in the course of several recent articles, the question whether an electric supply or tramway company should or should not be made responsible for the damage caused by the escape of electricity is assuming considerable importance, and is to form the subject of discussion before Parliamentary Committees during the present session. The distribution of electricity as a means of light and power naturally involves the laying of cables in close proximity to the numerous iron pipes which run beneath the streets; as the pipes and wires are generally hidden away, it is not easy, under existing conditions, to detect the existence or growth of the mischief in its early stages. As we have recently stated, however, the likelihood of electrolytic trouble in this country where so many precautionary measures are taken, has been grossly exaggerated. But as the matter is bound to occupy a good deal of attention directly, the law relating to it is worth studying.

The attitude of Parliament upon this important question, in so far as it relates to tramways, has been as follows:—Instead of saddling the supply or traction company with liability by a clause to that effect in every private Act, the Legislature appears to assume that the existing common law is not sufficiently powerful to reach the offender, and adopts an intermediate course, the general effect of which may be gathered from a perusal of the following clauses, which are usually inserted in the private Act:—

1. The promoters shall employ either insulated returns or uninsulated metallic returns of low resistance.

2. The promoters shall take all reasonable precautions in constructing, placing, and maintaining their electric lines and circuits and other works of all descriptions, and also in working their undertaking so as not injuriously to affect by fusion or electrolytic action any gas or water pipes, or other metallic pipes, structures, or substances. . . .

3. The electrical power shall be used only in accordance with the Board of Trade regulations, and in such regulations provision shall be made for preventing fusion or electrolytic action of or on gas or water pipes, or other metallic pipes, structures, or substances. . . .

4. If any difference arises between the promoters and any other party with respect to anything hereinbefore in this section contained, such difference shall, unless the promoters otherwise agree, be determined by the Board of Trade, or, at the option of the Board, by an arbitrator to be appointed by the Board, and the cost of such determination shall be in the discretion of the Board or of the arbitrator, as the case may be.

5. The expression "the promoters" in this section shall include their lessees, and any person owning, working, or running carriages over any tramway of the promoters.

The corresponding clause which is inserted in the provisional order authorising the laying down of electric lines for lighting or power purposes, is at best a compromise, and not an explicit statement that the undertakers shall be held responsible for all injuries. Sec. 18 of the Schedule to the Electric Lighting Clauses Act, 1899, provides as follows:—

(3) Where the operators lay any electric line crossing or liable to touch any mains, pipes, lines, or services belonging to any gas, electric supply, or water company, the conducting portion of the

electric line shall be effectively insulated in a manner approved by the Board of Trade; and the undertakers shall not, except with the consent of the gas, electric supply, or water company, as the case may be, and of the Board of Trade, lay their electric lines so as to come into contact with any such mains, pipes, lines, or services, or, except with the like consent, employ any such mains, pipes, lines, or services as conductors for the purpose of their supply of energy. (4) Any question or difference which may arise under this section shall be determined by arbitration. (5) If the operators make default in complying with any of the requirements of this section, *they shall make full compensation to all owners affected thereby for any loss, damage, penalty, or costs which they may incur by reason thereof;* and in addition thereto they shall be liable for each default to a penalty not exceeding £10, and to a daily penalty not exceeding £5. Provided that the operators shall not be subject to any such penalty if the Court are of opinion that the case was one of emergency, and that the operators complied with the requirements of this section so far as was reasonable under the circumstances, or that the default in question was due to the fact that the operators were ignorant of the position of the sewer, drain, watercourse, defence, main, pipe, syphon, electric line, or work affected thereby, and that that ignorance was not owing to any negligence on the part of the operators.

Looking at the above section it is clear that the offence for which the undertakers are to be liable is "default in complying with the requirements of the section," which include a number of duties other than those above referred to.

From the foregoing provisions it is not entirely clear that an express duty is cast upon the promoters to make good any damage occasioned by electrolysis; in fact, it seems that in cases where the promoters could show that they had complied with the reasonable requirements of the Board of Trade, they would escape liability altogether. The Board of Trade is not always the most satisfactory of tribunals for determining such a question. The reference to an arbitrator undoubtedly gives the disputing parties a satisfactory opportunity of laying bare their grievances, but there is no guarantee that arbitrators in different cases will base their awards upon similar principles of law. It is conceived that such cumbersome machinery was entirely unnecessary, having regard to the common law which applies to the promoters of electrical undertakings, as well as to all other owners of property, from whose premises some dangerous commodity is liable to escape and do damage to the neighbour's land. It has long been decided that the owners of gas pipes are rateable, either directly or indirectly, upon the property which lies over the gas mains, and the same remark applies to electrical mains, the owners of which are in effect rateable in respect of the land occupied by their mains. Hence if anything likely to do damage should escape from land so occupied, the owners, upon the authority of the famous case of Fletcher *v.* Rylands, would clearly be liable.

It may be remembered that in Fletcher *v.* Rylands the question was whether the owner of an artificial lake—the waters of which had escaped in a time of extraordinary flood—could be held liable. It was decided that he was liable on the ground that he had himself brought the dangerous element on to his premises, and should, therefore, be responsible for its being kept under proper control. So if a man keep a dangerous beast as a pet, he must be held responsible for any injuries which it may occasion to any of his Majesty's liege subjects. It has not yet been decided in our courts whether electricity is a dangerous "substance," the escape of which may render the promoters liable to pay damages; but it is submitted that the Court would be bound to say "*Res ipsa loquitur*," or in other words, that the very fact of injury was sufficient evidence that there was negligence on the part of the promoters in allowing the electricity to escape.

The section to which we have alluded is subversive of this principle, and in our view is unnecessary in so far as it provides for arbitration. Assuming that the best way of ensuring the adoption of a proper and effective system of insulation is to saddle the promoters with liability for injuries occasioned by electrolysis, we are of opinion that the common law affords sufficient protection to those whose pipes are affected, and that the question of liability might well be left to the ordinary legal tribunals. In their own interest, the undertakers of any electrical scheme will endeavour to keep their supply to themselves.

Although the important question above discussed has not been the subject of dispute in our own law courts, it was considered and decided in the case of the Manufacturers' Natural Gas Company *v.* Indianapolis Street Railway Company, which was recently heard in Indianapolis, U.S.A. The following is an extract from the judgment:—

> The method in use by the defendants in operating their cars results in serious injury to, and, in some cases, destroys the plaintiffs' pipes. The defendants can, by use of an approved appliance, at reasonable expense, so operate its cars as to avoid injuring the plaintiffs' pipes; while the plaintiffs cannot, by any known method, protect their pipes from injury. The plaintiffs own the pipe line laid in the street by legal authority, and such pipe line is property within the meaning of the constitution and laws. It is subject to taxation, and it may be sold and purchased like other property. The street railway company seizes on these pipes, and makes use of them as a conductor for their return current, and, in so doing, greatly injures, and, in some instances, wholly destroys them; and this is done under a claim that they are performing a public service under legal authority. Is not this a taking of private property for public use, and for which just compensation must be made?" These questions are new, and we are without precedent in decided cases for our guidance; but as these new questions arise, the administration of the law should keep step with the new situations arising in the march of scientific invention and improvement, not by inventing new legal principles, but by the expansion of old and well-recognised principles of law and equity, so as to meet and cover each new situation. It would be a reproach to our system of jurisprudence and the administration thereof if a situation could arise in which large and material injury should be done to legal rights and destruction caused to property while the law was powerless to apply a remedy. . . . Where a corporation is exercising a public franchise, and does so in such a manner as to cause actual material injury to legal rights and destruction of property when at reasonable expense by the adoption of well-known and approved appliances the injury could be avoided, and the person injured is powerless to prevent or guard against such injury, then I think it must be held to be negligence in the use of its franchise on the part of such corporation not to adopt such approved appliances.

The rule above referred to has been applied in England to an electric tramway, which, using a strong electric current, discharged it into the ground, thereby interfering with the operation of a telephone line. Thus in the case of the National Telephone Company *v.* Baker (1893), 2 Ch. D. 201, to which we have made allusion more than once in these columns, the Court held that the tramway company would have been held liable for all damages resulting from the discharge of electricity into the ground had it not been authorised by statute so to do.

A Plea for Fairness.

The correspondence which has been taking place in the *Times*, during the past week or so, in regard to the Metropolitan Electric Supply Company and its undertaking, seems to exhibit a determined spirit of hostility on the part of certain agitators who are not, judging by their sentiments, prompted by feelings of

the strictest justice according to true British traditions. It looks almost as though there were a movement on foot to reduce the market value of the stock to the uttermost. The local authority of Marylebone, as we have already stated in these columns, is anxious to get possession of the company's undertaking, and because it cannot get its way by fair means it will adopt others. We can see no reason why the Borough Council should be allowed to come into competition with the company, nor do we see why anything below a fair and just valuation should be paid for the undertaking. Whether unjust competition is to be allowed is a question happily to be left for Parliament to decide. If the local authorities at Liverpool, Sheffield, Birmingham, and a dozen other places in the provinces, considered it mere justice a few years ago to pay a good price for undertakings which had been pluckily established by pioneering engineers and investors in the early days of electric lighting, when municipal enterprise had not been awakened, surely the first city of the Empire is not going to indulge in the exercise of a lax morality! As the matter stands it is for the House of Commons to decide whether competition of any kind is to be allowed in the district, and if so, whether the rival undertaking shall be managed by a company or by the local authority. We hold no brief for any of the parties whose interests are affected, but our own view certainly is that there should be no competition whatever. If, however, Parliament deems that the unfortunate circumstances which have arisen in connection with the company's supply warrant rivalry, then a private company, and not the Borough Council, is the proper competitor. But the fairest way of all lies in the direction of purchase at a legitimate and reasonable figure, that is, if municipalisation will be a balm for this particular wound, which we something more than doubt. If the Marylebone Council wins the day, all the private town supply plants in the kingdom are placed in jeopardy. Really it is an impossible situation! The electric supply industry ought to organise itself for a vigorous effort, for the municipal mania against electric lighting companies is becoming distinctly dangerous. There seems to be a growing notion that if a thing is a monopoly therefore it is evil, save and excepting when it is a municipal monopoly; then, of course, it is the one and only panacea for a catalogue of painful maladies. If municipal enterprise is to be placed on a substantial and satisfactory basis, let it be above all things irreproachable in elementary fairness.

The Institution of Electrical Engineers.

By an unforseen alteration in the programme of last week's meeting of the Institution, we were unintentionally led into an unfortunate and regrettable error.

We received the draft list of officers to be nominated by the Council for the next Session from the Secretary of the Institution on Thursday afternoon last week, with the usual request that it should be regarded as "confidential until after the announcement is made at the Ordinary General Meeting this evening."

Now, as the Electrical Review is not published until Friday morning, there can clearly be no objection to the insertion of news of this description, and, as a matter of fact, the information was supplied to us for that purpose. Owing, however, to the necessity of "going to press" before even the meeting had commenced, we could not verify the facts, but were obliged to assume the *rôle* of prophet in the past tense!

As it happened, the announcement of the list was unexpectedly postponed. Our contemporaries, who are in the happy position of having plenty of time to make their appearance, were able to cut out the paragraph, but for us it was impossible. We can only express our regret at the unfortunate occurrence, and respectfully beg the Council in future to make up its mind beforehand, and to carry out its intentions.

While we are on this subject, we wish to add a few words on the attitude of some member or members of the Council itself towards its deliberations. It goes without saying that the proceedings of Council are essentially private, and that to prematurely divulge what passes at the Council table is to commit a gross and unpardonable breach of honour. It is not less improper for the editor of a quasi-technical journal to take advantage of such communications and to comment upon them in his publication.

We feel bound, therefore, to draw attention to the fact that some such proceedings have taken place in connection with the forthcoming election of Officers and Members of Council of the Institution, and to record our unqualified disapproval of such conduct.

Electrical Standards.

An article by Mr. H. F. Parshall, dealing with the standardisation of electrical apparatus appeared in the first number of *Traction and Transmission*. It should form a very good basis upon which to found a movement to establish a standard for rating the capacity of generators and motors, such as we have often called for.

The various quantities recommended by Mr. Parshall in this article for temperature limits, insulation thicknesses, insulation tests, &c., are those which have been found to be entirely satisfactory in practice. Most engineers will agree with him that the temperature measurements should be made by the resistance method, and not with the thermometer. For insulation tests the high pressure used should not be continued for long periods of time, because of the injurious effect which it has on the material of which the insulation is made.

One of the most difficult conditions which English engineers put into their specifications for generators, is that they must run at 460 volts with a current capacity of a given value when working as shunt machines, and when working as compound machines they must work at 550 volts with the *same* current capacity, while in both cases no shifting of the brushes or sparking is allowed. The output of the machine, under these conditions, is always based upon the lower voltage, whereas it should obviously be based upon the higher pressure. Another serious difficulty met with in this country in the design of large generators of the direct current type, is the speed which is often specified for machines of large capacity. It is not possible to build a good machine of large capacity, running at the high speeds so frequently specified. We think, therefore, that a standardisation of speeds and capacities for generators should also be taken up, as well as a standardisation of temperatures, insulation, &c.

The Control of Electric Cars.

We venture to think that the illustrated article which we reprint from the *Scientific American* on another page of this issue will be read with considerable interest by electric tramway managers throughout the United Kingdom. It is very desirable that the human element in this matter of speedy electric cars should be as efficient as human means can make it, and elementary training of car drivers, such as the New York Metropolitan Tramway Company finds so serviceable, would avoid many a street scene, would save a hundred little annoyances to English tramway officials, and would be bound to result in a greater immunity from accident. The safer we can make it, even for those representatives of the populace who in their walks abroad cannot or will not take care of themselves, the better will it be for electric traction. The tramways accident account has not been so low as might be wished in certain English cities, and very likely a small outlay upon an educational equipment would pay for itself over and over again in a very short period. We do not forget in this connection that the Glasgow Corporation Tramways Department, under the able guidance of Mr. John Young, adopted such an idea a year or two ago. Arrangements were made for the systematic training of a sufficient number of the existing staff of drivers. A skeleton school car was built, and the men were put through a course of instruction, both in regard to the electrical equipment and electric car driving. The men received the usual wages while receiving the tuition, but doubtless subsequently they were worth considerably more, and were paid accordingly.

D

THE CHARACTER OF THE BRUSH DISCHARGE.

A recent paper by Karl Przibram in the *Akad. Wiss. Wien* describes an interesting series of experiments made with a view to investigating the nature of the brush discharge by photographic methods. According to an observation of Beccarias, mentioned in Wiedemann's *Elektricität*, p. 616, Sec. 806, the negative brush in free air has a higher tone than the positive. The determination of the rate of intermittence by the corresponding tone is very difficult, however, especially when measurements are to be made in various gases; consequently some kind of stroboscopic method has to be adopted. Since the intensity of light from the brush is low, the use of a rotating mirror, such as was employed by Feddersen for the analysis of oscillatory discharges, is practically out of the question.

For the same reason, the projection of the images upon a moving photographic plate, after the manner adopted by B. Walter (*Wied. Ann.*, Bd. 66 (98) p. 636), is also unlikely to give good results. Przibram therefore adopts the plan of discharging the electrode directly upon a rotating photographic film. The film takes the form of a disc, rotating upon an axle. The two electrodes are placed respectively at distances of 4·5 and 9 cm. from the axle and parallel to it. They are of copper wire, about 1 mm. diameter, and are brought nearly into contact with the film disc. The sparks are obtained from an influence machine, connected to Leyden jars 4 cms. diameter, and 8 cms. length of tinfoil, as shown in fig. 1.

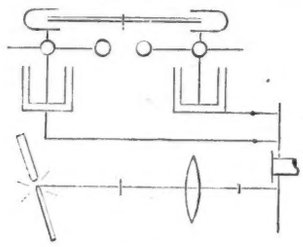


Fig. 1.

The speed of rotation of the film disc is measured by directing a beam from an arc lamp through a slit upon the film. A tuning fork is interposed between the slit and the film, in such a position that it extinguishes the slit at each vibration, thus causing a series of corresponding known exposures upon the film, which, when developed, can be used to indicate time intervals.

With this apparatus a record is obtained of the series of discharges, showing the principle discharge followed by a set of weaker ones. The brush is seen at its best at the cathode; it is greater there than at the anode, and it is there most persistent. The general character of these discharges is seen in fig. 2, which is from a photograph of one of the films.

It was found to be rather difficult to adjust both electrodes simultaneously with respect to the film; in the later experiments, therefore, one electrode only was put into position, the other being insulated. The mean values of the intermittence are given in the following table, for air and for CO_2 respectively, in seconds:—

	Time interval of discharges.		Total time of complete discharge.	
	+	−	+	−
Air ...	$6{\cdot}8 \times 10^{-4}$	$1{\cdot}1 \times 10^{-4}$	33×10^{-4}	42×10^{-4}
CO_2 ...	$3{\cdot}9 \times 10^{-4}$	$1{\cdot}3 \times 10^{-4}$	15×10^{-4}	60×10^{-4}

For the experiments in CO_2, the rotating film-disc was put into a wooden box.

According to Wiedemann (*loc. cit.*) the greater brush discharges at the negative electrode indicate lower negative discharge potential. This supposition would explain the fact that the discharges at the cathode continue after those at the anode have ceased. In the case of CO_2, the relationship of the total times of complete discharge of the two

Fig. 2.

electrodes, indicates a proportionally less negative potential discharge. This has been referred to by H. Sieveking, *Wied. Ann.*, IV., Bd. 1, p. 299 (1900). It is, however, rather contradictory that the single positive discharges in CO_2 follow one another more quickly than those in air. It should be noted that the successive brush discharges in CO_2 are very weak, therefore only small quantities of electricity are in motion, and the potential of the electrode falls comparatively little at each discharge.

INSULATION ON CABLES.

(*Concluded from page* 659.)

As now made, cables are often inversely "graded." A large class of fibre cables are given their final impregnation by immersing them in their entirety in a tank full of a mixture of an oil and some solid hydro-carbon, which, as in the case of resin, frequently has a higher specific capacity than the oil and paper, as well as a greater disruptive strength.

During the process of this impregnation, the fibres of the outer layers have the effect of filtering the solute from the solvent, and although the oil reaches and fills up all the pores of the innermost layers of paper, the solid is filtered away and only reaches the outer portion of the dielectric, which consequently has the greater dielectric strength and capacity, where they are not wanted.

That the dielectric strength should be greater in this particular position is of little consequence, but that the capacity should be greater is a danger, because it tends to make the potential gradient steeper even than it would be in a homogeneous dielectric close to the conductor. On the other hand, it would be worth trying to utilise this fact to graduate the conductivity or capacity by choosing the oil and solid dielectric to have a suitable viscosity at the temperature of the impregnating tank.

A similar faulty arrangement is met with in ordinary vulcanised rubber cables. The pure rubber which is placed next the conductor has a specific capacity of about 2·3. The high-class compound which comes next to this may have a capacity of 2·6, and be 50 per cent. stronger; the outer layers, which are almost invariably made of lower-grade material, have often a specific capacity of three and more, a very poor insulation resistance, and strangely enough, in some samples, up to three times the dielectric strength.

The layers of insulation on such cables are arranged in

the opposite order of capacity to the most efficient, and are only enabled to stand because the vulcanised compound rubber has a sufficiently uniform texture and high dielectric strength. There is no question that, bulk for bulk, the best vulcanised rubber is stronger than the best impregnated paper, and its day will come when really high pressures are used; just now it needs all its dielectric strength to compete in cost. On armoured cables their lesser diameter results in such a saving of steel tape as to allow rubber core to win in the price competition.

At present rubber-covered H.T. cables have as much as double the capacity of fibre cables. This is due (1) to the specific capacities being as 3 to 2, and (2) to the superior dielectric strength of rubber which allows the conductors to be placed nearer together. In non-concentric cables this capacity can be diminished by adding, if required, a bed or worming of jute, &c., and the reduction can be more cheaply done with rubber than if there is to be a coat of lead over each wire, which is the safest way with three-phase hygroscopic cables other than feeders.

The capacity of a perfectly graded cable is found by Mr. C. S. Whitehead to be in all single and concentric types, inversely as the radial depth of dielectric, and the curve of potential is a straight line. The last part of Mr. O'Gorman's paper deals with the problem of determining the best thickness of dielectric as regards efficiency and price; his calculations are based on a formula proposed by Mr. Swinburne. Unfortunately the calculations depend to such a degree upon the constancy of dielectric strength that the results can only be regarded as tentative.

In the discussion which followed the reading of the paper, Mr. Swinburne, it appears to us, summed up the question of cable design along these lines very accurately when he said that the best cable would be a matter of compromise and experiment, and was not a thing which could be calculated carefully. At the same time we warmly congratulate Mr. O'Gorman upon his attempt to bring the art of cable making into the region of precise arithmetic.

The significance of the potential gradient in cable design was pointed out by Mr. Swinburne in 1892 (*Jour. Inst. Elec. Eng.*, Vol. xxi., p. 226). He then reminded us that difference of potentials is only one of the factors that determine disruptive discharge, and that the question to be considered is not the average fall of potential taken across the whole radial thickness, but the maximum rate of fall, which is at the surface of the wire. Mr. O'Gorman tries to avail himself of this, and to design an effective cable on economical principles by grading the successive layers of dielectric. It is a pity that practical considerations stand in the way of carrying out such a pretty scheme. The cable maker weighed down by the tremendous responsibility of his own reputation, is obliged to choose a design that will stand fair wear and tear, and that will not be valueless when the inevitable weak place appears. For this reason he prefers to use a dielectric which is fairly good all through to one in which the strength is localised in a few thin layers. He has, in fact, to anticipate the presence of a bubble or a bit of copper dust in those thin layers. He is also aware that in the multiplicity of layers there is weakness and expense, for each layer encloses its film of moisture and dirt, and each layer means an extra man or two at the machine. The material has to be sufficiently thick to withstand the stress of the covering operation. The purer layers, of india-rubber say, could be comparatively thin, but the pigmented layers must necessarily be thicker or they will break off in the machine. One cannot do much in a millimetre. It is as well, therefore, to keep to the rule of three. In the case of cores of such material as gutta-percha, where the successive layers depend for their adherence upon a mixture such as Chatterton's compound, it would be very risky to exceed that rule; for the compound might act injuriously upon the layers, whether the dielectric be paper, india-rubber, or what not. It can be accepted as a general principle that the greater the multiplicity of layers, the greater the number of chance paths for present and future dirt and moisture. There is virtue in solidity. If, however, the layers are, as it were, welded together by heat, or caused to interpenetrate by the use of oils, this difficulty might be lessened. But then we are met by the complex question of the effect of this surface-mixing upon the dielectric constants of the various layers, and it is extremely doubtful whether the "grading" would come out right after the process. It might even be reversed.

The cable maker who tries to make a "graded" cable is also confronted with the difficulty of obtaining by a proper choice of materials a series of mixtures of the required simultaneous specific inductive capacities, specific resistances, and dielectric strengths. These qualities cannot easily be attained by calculation, and when they have been attained, who knows how long, and under what circumstances, they will keep their values? The problem has been attacked in part by Dr. C. H. Lees in a paper read before the Physical Society, November 24th, 1899. He alludes to the case considered by Maxwell, who worked out the conductivity of a compound medium formed by embedding spheres of a given material in another medium of different conductivity. Maxwell also worked out the conductivities for two other cases of compound media. (1) When the two media are separated by planes either parallel or perpendicular to the plane equipotential surfaces in the media; and (2) where the parts of the two media consist of right prisms of rectangular cross-section, one dimension of the cross-section being infinitely great compared to the other, and the length of each prism being again infinitely great compared to this greatest cross-sectional dimension, placed with their edges either parallel or perpendicular to the equipotential surfaces. It is pointed out by Dr. Lees that these three cases have restricted application only; he, therefore, takes the more general case of a medium formed of an equal number of infinitely long prisms of square cross-section, of two media having conductivities K_1 and K_2 arranged like the squares on a chequer-board, and bounded by two parallel equipotential planes drawn through the diagonals of the cross-sections of the prisms. Dr. Lees recognises the difficulty of selecting a distribution of the prisms which shall represent the general case of conduction through such a mixture, but he arrives at three equations corresponding to three definite cases. The conductivities determined for successive equal increments of one constituent of the mixture, correspond for the first equation to the successive terms of an arithmetic series, for the second to the terms of a harmonic, and for the third to those of a geometric series. The meaning of this is that a manufacturer is unable to calculate the electrical constants of a dielectric mixture from the known constants and proportions of its constituents; the resulting compound may have a value corresponding to the arithmetic, the harmonic, or the geometric mean, or to neither of these. Moreover, the results of his most academical pretensions to refinement in mixing may be marred by some difference in preparation and cure. And beyond all that he must take account of the change of the dielectric "constants" with time, he must keep within the limits of price, and he must sell an article at least as durable as his reputation.

ELECTRIC TRACTION IN THE COLONIES

One would hardly expect to find all the home Board of Trade restrictions and regulations for the proper conduct of an electric tramway enforced in so comparatively far distant a spot as the capital of British Guiana, or, rather, of Demerara—Georgetown.

A town either in South or Central America might very well consider that such luxuries may suit an old-established country like Great Britain, but that a rising place and district must be allowed some latitude in methods, especially when the neighbouring continent on the north is filled with electric traction systems constructed and worked more or less on a method of trial and error.

It is, however, doubtless due, in the first place, to the fact that this is a British colony, and, in the second place, to a further fact that the promoters are also British, being Canadians, that the Georgetown electric tramway system just lately completed, and a description of which is published in the current issue of the *Street Railway Journal*, should rejoice in such familiar conditions and obligations as street maintenance between rails and tracks and for 18 in. outside; also a minimum drop

of 7 volts in the return between the ends of the line and the power house, with all the other Board of Trade rules in this connection.

Still more, it labours under the further burden of having been called upon to raise all the telephone wires clear of the trolley wires, to put up properly earthed guard wires, and fix fuses on all the lines. This is a good deal more than electric tramways in the home country are called upon to do for the National Telephone Company, but the reason why will be easily understood when it is stated that the Government itself runs the telephone service in Georgetown; hence the conditions.

It is, perhaps, hardly fair to think that British-made machinery should have been supplied for this tramway system, considering the greater nearness of the United States, and the enormous facilities there available for buying reliable electric traction plant at a reasonable rate, even though the promoters were not in this case American.

The only comfort to be derived is that Scotch engines are used for driving some of the generators, and Canadian-made engines for others. The rest of the plant is all Babcock and Wilcox and Stirling for boilers; McIntosh, Seymour and Co., the Westinghouse and General Electric for engines and generators.

The power house is a combined one for both lighting and traction, the former plant having been at work for some time now to a capacity of some 1,000 H.P.; the charge for energy is 1s. per unit for private lighting, and 7½d. for public purposes. The tramway plant has a capacity of about 500 H.P.

Coal costs nearly 30s. a ton, which explains to some extent the high price of current.

Georgetown itself, and, indeed, the whole district, is built practically on a thin deposit of mud overlying soft clay, considerably below sea level, and the ocean is kept out by means of sea walls. It may therefore be imagined that some difficulty would be met in securing not only proper foundations for generating plant at the power house, but also for the street poles, and even the track itself in the streets, there not being much more than a few inches of really hard surface.

The poles in the streets had to be set in holes 5 ft. deep, of considerably larger diameter at the bottom than at the surface; they were packed on solid wood blocks 3 in. thick, and the holes then filled up with concrete; but even this did not make and keep them altogether stable, and repeated tamping had to be done in order to get any permanent strain on the poles.

The Georgetown Company may, however, feel pleased at its car speed limit being allowed to reach a maximum of 8 miles per hour in the city, and 12 outside. If the cars maintain two-thirds of this speed as an average, they will do a great deal better than some we know of, on lines far nearer to the Board of Trade offices than is Georgetown, Demerara.

CURRENT SPECIFICATIONS.

LVIII.—ALLOA ELECTRIC LIGHTING PLANT.

SUMMARY.

Extent of Contract.—Section 4.—Supply and erection of public arc lamps, complete with pillars. Contract No. 5.—Supply of sub-station equipment and sundry connections.

Number of Arc Lamps.—21 lamps, 19 of which are to be complete with posts, one to be mounted on bracket, the remaining lamp to be spare.

Type of Lamps.—To be direct current 17-hour single-carbon lamps, each taking 10 amperes, and to be suitable, if required at a later period, for burning nine in series on a 440-volt circuit.

Alternative Offer.—It is open to tenderers to send in an alternative offer for "enclosed" type lamps if they can show similar lamps in use on a large scale burning in series on a 440-volt circuit successfully.

Type of Pillars.—Pillars to be of general character shown on drawing issued with specification, arranged with scroll bracket arm so that height from ground level to centre of arc is approximately 20 ft., and the projection of bracket 4 ft.

Type of Sub-station Switchboard.—To be suitable for use on a three-wire direct current system, with three panels for positive, negative, and neutral bars respectively, provision being made for the addition, at a later date, if desired, of a booster and battery panel.

Type of Arc Lighting Board.—To be arranged for five circuits each 10 amperes and taken from the neutral to one of the outer conductors.

Specified Dates of Completion.—To be stated in tender in each case.

Penalty for Late Completion.—One per cent. of total contract sum per week.

Specified Terms of Payment.—Monthly payments up to 80 per cent. of work executed, 10 per cent. on completion, 10 per cent. at end of 12 months.

Period of Maintenance.—12 months from date of completion.

Amount of Surety Required.—20 per cent. of contract amount guaranteed by two sureties jointly and severally bound in the above sum.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—None.

Arbitration Proposals.—Acceptable, see comments below.

Date for Receipt of Tenders.—April 30th, 1901.

This specification has been prepared by Messrs. Buchan and Hogarth, consulting engineers, of Edinburgh, who are advising the Corporation of Alloa with regard to electric lighting matters.

The plant and apparatus included in Sec. 4 of this specification refers to the lamp-posts and fittings for the first instalment of public lighting, while Sec. 5 relates to the switchboards and fittings required for a control sub-station in the centre of the town.

The arc lamps are to be of the single carbon 17-hour 10-ampere type, it being permissible to offer as an alternative "enclosed" type lamps if the tenderer can prove they have been in successful use for more than 12 months working in series on a 440-volt circuit.

The requirements in each case are clearly specified, and there is no attempt to in any way unduly hamper tenderers in the preparation of their offers.

The general conditions are in some respects special, though, on the whole, conceived in a fair and impartial spirit.

After the usual stipulations protecting the purchaser against any omissions in the specification, we find in Clause 5 power reserved to the engineers to vary the work to be done under these contracts to the extent of *20 per cent.* of their value, without conferring upon the contractor any right to compensation or extra allowance.

We are glad to note here the recognition of a principle, for which we have for long contended, viz., that the power of the engineers to vary work shall be limited to a percentage value of the whole contract, though, in our opinion, this percentage should not exceed 10 per cent. without the contractor having the right, if he thinks fit to exercise it, of revising his figures.

The terms of payment are fair, monthly instalments being paid during manufacture, the last 10 per cent. only becoming due at the end of the 12 months' period of maintenance.

Securities, two in number, to be jointly and severally bound in the sum of 20 per cent. of the contract amount are to be provided by the successful tenderer.

The arbitration clause is drawn up in a form we think to be peculiar to Scotland. The decision of the engineers as to the quality of the material supplied and the manner in which the work is being carried out is to be final. Any other dispute is to be referred to the decision of Mr. W. A. Chamen, the electrical engineer to the Corporation of Glasgow, who is to act as sole arbitrator, his decision being binding on both parties. If for any reason Mr. Chamen is unable to act, the arbitrator is to be nominated by the acting President of the Institution of Civil Engineers.

This practice of referring a dispute to the decision of a well known and trusted engineer has much to commend it, and we think that it would do much to soften business disputes if it became a more usual custom in this country.

LEGAL.

METROPOLITAN ELECTRIC SUPPLY COMPANY, LIMITED *v.* GENDER.

THIS case came on for trial last Friday before Mr. Justice Buckley in the Chancery Division of the High Court of Justice. Mr. Astbury, K.C., and Mr. Sargeant appeared for the plaintiff company, and Mr. S. Eady, K.C., and Mr. Stewart Smith for the defendant.

Mr. ASTBURY, K.C., explained that the action was one to restrain the defendant from taking his supply of electric energy from any company other than the plaintiff company for a period of not less

than five years from the date of agreement. The matter came before his Lordship on an interlocutory motion, and evidence was filed by both sides. Defendant made certain statements in his evidence with regard to a gentleman named Wright, one of the employés of the plaintiff company. Mr. Wright had dealt with these in his affidavit, but, unfortunately, he was now suffering from a serious illness and was unable to attend. He desired to know whether defendant would accept a doctor's certificate as to that gentleman's illness. Mr. Wright's evidence would have been of great importance to the case, but he was prepared to proceed without it.

Mr. Eady, K.C., said he would accept the doctor's certificate.

Mr. Astbury proceeded to state the case. He explained that the agreement entered into between the plaintiffs and defendant was dated November 16th, 1898. The supply was to be for not less than five years and the charge was stated as 4½d. per unit. That agreement was purely negative, because the company was bound by Act of Parliament to supply all that was required. In September, 1900, the defendant ceased to take the energy from the plaintiff company and began to take it from the County of London and Brush Provincial Electric Light Company. That company had concurrent powers to supply energy in Holborn. As soon as the plaintiff company learned this they wrote defendant a letter pointing out that he had broken his agreement, and requesting to be furnished with the name of his solicitor unless he at once complied with the terms of the contract. Defendant then had an interview with Mr. Page, plaintiffs' superintendent. In that interview defendant stated that he had no reason for ceasing to take the light other than that the County of London Company's representative had been such a nuisance canvassing him to change that he at last agreed to do so in order to save himself further trouble. Defendant further told Mr. Page that the County of London Company's canvasser informed him that if he took their supply, they would, in the event of litigation, see him through. This action was being defended by the County of London Company's solicitor, and he (Mr. Astbury) thought there could be no doubt as to how the litigation had really arisen. During the interview defendant never suggested that he had any complaint concerning the quality of the light supplied by the plaintiff company. On October 2nd, 1900, the defendant wrote a letter to Mr. Page, stating that he was in communication with the County of London Company, and that he hoped to settle the matter satisfactorily to the plaintiff company. Defendant continued to take the light supplied by the plaintiffs until February 25th, 1901, when he wrote them as follows: "As I am dissatisfied with your light, I have instructed another company to fix up their light, and I am now using the same. I shall feel obliged if you will come and take your meter away, and let me have your account up to date, as I shall object to pay the rent of your meter after to-day." Proceeding, counsel said defendant now represented that he had entered into no agreement for a period of five years, and that from the time he took possession of the public house, he had continual cause for complaint concerning the company's light. Defendant declared that not only was the light poor, but the filament in the lamp would become red, and give no light; then there would be a sudden flare, and the lamps would be destroyed. It would be possible to show his Lordship what the voltage was during that period. In that manner defendant alleged he had at least 20 lamps destroyed, and the supply was so bad, that he had to remove an arc lamp outside his premises and have another lamp placed there at a cost of £60. On February 1st last he was at the public house at 6.20 in the evening, when the light suddenly went out, and gas had to be used. Other people who were on the same circuit, and who had their lamps lit at that hour, would speak as to this point. It would be impossible for the light to go out in one place and not in another, unless owing to bad fittings, for which the company was not responsible.

Evidence was then called.

Mr. Edward Swanborough, manager of the Royal Music Hall, Holborn, examined by Mr. Astbury, said the whole of the electric light for these premises was taken from the Metropolitan Electric Supply Company. With the exception of one day three years ago, when an accident occurred at the Sardinia Street electric works, he never had had any cause to complain as to the quality of the light supplied by the plaintiff company. The accident at the works necessitated the music hall being lit by gas for one evening. He found the electric light thoroughly satisfactory during the winter of 1899—1900, and also in January and February of this year. If the electric light supplied to the hall had been dim or if the energy had ever been so great as to destroy the lamps in the music hall, he would have known.

Cross-examined by Mr. Eady, K.C., Witness said he could not give any record at all as to how long the electric lamps lasted.

Mr. J. C. Ackerman, manager of the restaurant adjoining the music hall, said that he only remembered one occasion on which the light failed, and that was in January, 1898, and before the defendant entered into his agreement with the company. Occasionally a lamp broke in the restaurant, but he did not consider that that was due in any way to an excessive electrical current. He was quite satisfied with the supply from the plaintiff company.

Cross-examined, Witness said he had always found the light a steady one. He could not speak as to the terms upon which the light was supplied to the restaurant.

Mr. Gates, proprietor of the Vienna Café, 24 to 28, New Oxford Street, examined by Mr. Sargeant, said he had received his supply of electric light from the plaintiff company for the past nine years, and he had found it very satisfactory. His lamps also went out on the day of the fire at Sardinia Street electric works three years ago.

Cross-examined, Witness said he only remembered one occasion when the light failed. The current varied sometimes. On Sundays, for instance, the light occasionally was not so strong as during the other days of the week. The variation, however, was not so marked as to justify a complaint. At one time he had an electric lamp outside his premises. That was now discontinued, not because the light was unsatisfactory, but because of the cost of keeping it lit. He was charged 4½d. per unit for the electric light up to three months ago, but now the rate was 4d. At one time he had paid as much as 6d. for the electric light supplied by the company. His experience was that an electric lamp lasted about 400 or 500 hours.

Re-examined by Mr. Astbury, Witness said that the lamps he used were English lamps, supplied by the General Electric Company at 16s. per dozen for 16 c.p.

Mr. Eady, K.C., at this point raised the question as to whether the agreement upon which the plaintiff company based its case was a legal one. He said the agreement gave an undue preference to other consumers to the prejudice of defendant. In another sense it gave defendant an undue preference over certain other persons taking the plaintiffs' supply of electric light.

His Lordship: Do you complain that the agreement was too good for defendant?

Mr. Eady: I say it is an agreement illegal by statute. It contravenes the provisions of the statute. The statute requires a company to enter into an agreement on certain terms. This is an agreement outside the statutory power of the plaintiffs, and is not binding at all. It gives one person undue preference over another. The Act says we must be supplied on the same terms as anybody else.

Mr. Astbury: I submit that there is no ground for such a contention. The fourth schedule to the Confirmation Electric Lighting Act of 1889, Sec. 1, says:—"Where the undertakers charge any consumer by the actual quantity of energy supplied to him, they shall be entitled to charge him at the following rate per quarter. For any quantity up to 20 units, 13s. 4d.; and for each unit over 20 units, 8d." Secs. 19 and 20 of the Act of 1892, says:—"Where a supply of electricity is provided in a part of an area for private purposes then, except in so far as is otherwise provided by the terms of the license, order or special Act authorising such supply, every company or person within that part of the area shall on application be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply." The Act takes into account the circumstances and the amount of the supply. It goes on to say, "The undertakers shall not in making any agreements for a supply of electricity show any undue preference to any local authority, company or person, but save as aforesaid they may make such charges for the supply of electricity as may be agreed upon under the existing limits of prices imposed by or in pursuance of the licence, order or special Act authorising them to supply electricity." That limit is 8d., and in these circumstances my friend's objection is groundless.

His Lordship ruled that the objection was hopelessly irrelevant.

Mr. Camerer Kuss, who was the next witness called, said, in answer to Mr. Astbury, that he carried on business with his father at 36, New Oxford Street. It was necessary for the minute work of watch and clockmakers, to have a good light. For some years past he had taken his supply of electric light from the Metropolitan Electric Supply Company. Since November, 1898, up to the present time, he had found the light very satisfactory.

Cross-examined by Mr. Eady, Witness said that previous to 1898, the electric light might have failed four or five times in the course of a year. The supply had been regular for the past three years.

Were complaints frequently made by your workmen concerning the light, and did you see for yourself that the complaints were not unfounded?—Previous to 1898 complaints were rather frequent.

During the past three years have you noticed the light vary, and that it is sometimes stronger than usual?—No.

Mr. Reginald W. Todd, chief engineer to the Metropolitan Electric Supply Company, said, in answer to Mr. Astbury, that he had filled that position for the past two and a half years, and he had been in the employment of the company for three and a half years. The first year he was resident engineer at Willesden station. Defendant's supply of electricity went over the same network of mains as that for the other witnesses who had been examined.

Could defendant's light have gone out through the fault of the company without the lights of the other witnesses examined doing the same?—Defendant's light could not have gone out without our knowledge.

If the defendant's light had gone out because the supply ceased owing to some fault at the electric works, would not the same failure of supply have necessarily affected the other people on the same network of mains?—It is possible for his light to have failed and for the others to have continued, but if it had done so we should have known of it.

The light Gender gets must come from a main supplied by the company's works at Sardinia Street?—Yes.

And the other witnesses get their supply from the same series of mains issuing from Sardinia Street?—Yes.

They are driven by the same dynamos?—Yes.

Is it possible that the dynamos could fail to send energy down those mains in such a way that one person upon the mains could get light and other persons upon the same mains could not get light?—It is possible by the burning out of a section of the mains.

Supposing the section upon which Gender is had failed, everybody on that section subsequent to him must find their light fail, but the people on the main in front of him need not?—That does not necessarily follow.

You are very cautious. If Gender's loss of light occurred through a section of the main burning out the company must replace that section, but it was obviously not that cause because the light came on again. Except when a section of a main burns out is it possible

for the light to go out in one house on that main and the lights of houses on other parts of the same main to continue burning?—No, it is not possible.

The fault might be due to any of the switches or fuses belonging to Gender himself, and would be no fault of the company?—Yes.

From November, 1898, has any section of Gender's main ever burned out?—None.

Answering further questions, WITNESS said that if any complaints had reached the works as to shortage or bad light, they would have been brought under his notice. There had been absolutely no complaint brought to him from November, 1898, until February 25th this year of any failure to supply light to any house by the mains which fed Gender's premises. He was not in the employ of the company when the Sardinia Street station was destroyed by fire. He could not recollect anything happening in December, 1898, as regards the electric supply to the music hall in Holborn. About 14 days ago there had been a flare up of the light in the premises of Mr. Kuss. That was due to an accident to the mains. One of the junction boxes in the Strand had fused in an extraordinary manner, and caused a pressure to consumers. Nothing of the kind had occurred between November, 1898, and February, 1901.

Is it possible in your opinion that the lights on Gender's mains could suddenly have been so bad that the lamps merely glowed, and at other times the current so excessive that the lamps were destroyed to the number of 20 or more during the winter of 1899, and up to February, 1900, without your knowing of it?—Absolutely impos ible.

Are records kept at Sardinia Street of the voltage, and reports made daily to you of any excess or diminution in it?—Yes.

During the winter 1899, and up till February, 1901, was any complaint made regarding the pressure?—On three occasions. On November 16th, and early in January of this year, the pressure was slightly low.

Would the decrease in the pressure have put the lights out, and caused only a red glow?—Certainly not. There was only a decrease of pressure to the extent of 10 per cent. On one occasion there was an extinction due to some mains fusing up in our junction box. That accident was one prior to the one in the Strand. On January 6th, 1900, from 1.50 p.m. to 3.5 p.m., the mains were burnt out in Wych Street, and there was a total loss of light. The reductions were for a period of an hour on November 17th, 1900, and for a period of 20 minutes on January 8th, 1901.

Have we the misfortune to have your company's light in this building?—I don't think it can be called a misfortune; the Law Courts are supplied by us.

In reply to further questions, WITNESS said the company had not received any letter from the defendant on February 3rd last, and he had never heard of any having been received from defendant on September 3rd, 1900, concerning his supply.

Cross-examined by Mr. EADY, WITNESS said that in November, 1897, when at Willesden, he had nothing to do with the electrical supply of the company. He had not seen defendant personally concerning any complaints. The high pressure continuous current was supplied to the whole of the company's district about the middle of 1900.

Further cross-examined by Mr. EADY: It was a matter of notoriety that at one period they had not sufficient current to satisfy their obligations. That, however, did not apply to the Midland area. In 1898 or 1899 if they had wished they could have augmented the current in the Holborn District or their West area; that would be on the alternating supply but not on the continuous supply.

Mr. ASTBURY: This is rather like getting out our trade secrets.

Mr. EADY (to the witness): It is a fact that with regard to the supply that both in 1898 and 1899 there were constant complaints.

The WITNESS replied that there were, outside the Holborn area. If there were any complaints in 1898 and 1899 with regard to the Midland area they were of no consequence.

Further cross-examined: He had the records of the voltage at the Sardinia Street station. He had not got the reports with him. They were made from the daily record which was kept. That was a record of any failure or of anything going wrong.

Mr. EADY: I understood you had a record of the voltage?—No, we have it from our own logs. We keep a log of the pressure and current going out hourly, and these are entered up.

Mr. EADY asked that he might have the log book produced by the next morning.

Mr. ASTBURY said his clients would consider whether they would show the log book to this rival company.

At this stage the hearing was adjourned till Saturday morning.

The hearing was continued on Saturday and Monday, and concluded on Tuesday, when judgment was given in favour of the plaintiff company, the injunction being granted; but such injunction to be suspended for 14 days in the event of defendant appealing. Our report of the proceedings will be completed next week.

(*To be continued*).

FINCHLEY URBAN DISTRICT COUNCIL *v.* FINCHLEY ELECTRIC LIGHTING COMPANY.

IN the Chancery Division on Friday, before Mr. Justice Kekewich, Mr. Warrington, K.C., said that in the case of the Finchley Urban District Council *v.* The Finchley Electric Lighting Company, he had a motion to restrain the defendants from breaking up certain roads in the district of Finchley for the purpose of laying pipes to contain electric cables without having first obtained the consent of the plaintiffs as the highway authorities. His learned friend, Mr. Buckmaster, had now given him an undertaking that he would not open the roads without the consent of the plaintiffs, or without first giving notice of his intention to do so.

Mr. BUCKMASTER said he preferred that form of undertaking, as circumstances might arise which would entitle the defendants to open the roads without the consent of the plaintiffs.

Mr. Justice KEKEWICH said that if the roads were opened without consent upon notice, a fresh writ would have to be issued.

Mr. WARRINGTON said that was so.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"NON-LITIGIOUS" writes:—"I am a frequent contributor to technical journals, my articles sometimes appearing anonymously as editorials, and sometimes under my name. Upon many occasions my efforts have been subjected to harsh and wholly uncalled-for criticism at the hands of a daily paper, and although such criticisms are published anonymously they are false, or only partially true, and are seen and read by members of my profession and occasion me considerable annoyance. I am very anxious to avoid strong measures, but finding that letters to the editor produce no effect, I shall be glad to know whether the law provides any means which will enable me either to obtain redress, or to obtain an injunction to restrain the continued publication of such carping criticisms."

*** While we sympathise with our correspondent, we regret that we can hold out no hope as to the success of any legal proceedings which he may institute against the journal in question. By time-honoured custom recognised at most newspaper offices, all the journals dealing with a particular trade or industry interchange their publications, and journals so sent must, it is conceived, be regarded as books sent for review, and as such exposed to the merciless handling of some log roller who is told to fill so many columns with cheap criticism. We presume that in the case under notice, the journal for which our correspondent writes was sent in this way. Of course there *are* bounds beyond which even a reviewer must not venture—or he brings himself within reach of the law of libel; but we can well understand that there is a species of criticism which is not libellous—which may not even be untrue—but which nevertheless gives poignant agony to the writer of a review article, who, in honest endeavour to do his duty (or to earn his livelihood), has made some slip which a generous critic would not dream of mentioning. The writer feels such cruelty none the less that his handiwork is sheltered behind the editorial "we." Critics of the class referred to seldom have the courage to go beyond what is commonly known as "fair comment," and even assuming that their comments are unfair, the man whose work is disparaged must be able to show that he was injured in credit or estate. It is small consolation for such a one to reflect that the critic is one whose opinion does not carry much weight; but we are glad to know that the journal which annoys our correspondent is not one of high standing. Periodicials which fill their columns with such trash nearly always take the lowest place on the particular branch of journalism which they presumably seek to adorn.

PARLIAMENTARY COMMITTEES.

CALEDONIAN ELECTRIC POWER BILL.

ON Tuesday a Select Committee of the House of Commons, under the chairmanship of Sir James Woodhouse, commenced the consideration of the Caledonian Electric Power Bill. Mr. Balfour Browne, K.C., Mr. Baggallay, K.C., Mr. Moon, and Mr. Pitman appeared for the promoters, and there was a long list of petitioners against the Bill.

Mr. BALFOUR BROWNE, in his opening statement, said the Bill was a most important one, and there was a rival Bill which would follow on the Clyde Valley Electrical Power Bill. He was sorry that there should be two Bills before the Committee. It was proposed by the promoters of the Caledonian Electric Power Bill to form a company to supply electric energy for the great manufacturing district of Scotland, of which Glasgow was the chief centre. It was a most important problem of the day, as to how the manufacturers of the country were to hold their own against foreign competition, and a way of doing that was possibly by supplying cheap power. By a combination of the various manufacturing districts under one company, the company would be able to manufacture and generate electricity at a very cheap rate. As long ago as 1892 Mr. John Cunninghame, managing director of Messrs. Merry & Cunninghame, thought the time had arrived when an electric installation should be made for the whole district, but after consideration with eminent engineers, they concluded that the time had not yet arrived. Since 1892, however, a good deal had happened, and a number of Bills had been introduced for supplying electric power at a cheap rate to manufacturers. There was, he contended, an important

difference between the Caledonian Bill and the Clyde Bill, for while the Caledonian Bill did not propose to include the City of Glasgow within its area, the Clyde Bill did. The chairman of the promoting company was Mr. J. C. Cunninghame, and there were a number of other influential men connected with it.

The Committee proceeded to take evidence.

West and South London Railway Bill.

On Tuesday the Standing Orders Committee of the House of Commons agreed to dispense with the standing orders with regard to the above Bill. The Bill is one which seeks authority to construct an underground railway, to be worked electrically, from Paddington to Kennington Park, but notice had not been given to a number of owners. It was stated that the promoters were now prepared to insert the usual protective clauses for owners, and it was on this understanding that the standing orders were dispensed with.

ELECTRICAL ENGINEERS R.E. (VOLUNTEERS).

Regimental Orders, April 23rd, 1901.

1. *Change of Address*.—The new headquarters are now occupied, and in future all correspondence affecting the above Corps should be addressed

"The Officer Commanding
Electrical Engineers R.E. (Volunteers),
Regency Street,
Westminster, S.W."

2. *Recruit Drills*.—Drills for this year's recruits will take place at headquarters on Tuesdays and Thursdays, at 6.30 and 7.30 p.m.

3. *Uniform*.—All members not yet measured for uniform are requested to communicate with the Serjeant-Major at once.

4. *Trainings for* 1901.—The dates and places for annual training, 1901, will very shortly be published; those members of the Corps who have not yet replied to Camp Circulars should do so at once.

5. *Medals*.—The War Office have called for lists of all members of the 1900 detachment of the Electrical Engineers entitled to the South Africa War Medal. This is being prepared.

6. *South African Detachment*, 1901.—This detachment, under the command of Major A. Bain, which sailed from Liverpool in the ss. *Bavarian* on March 25th, 1901, arrived at Cape Town all well on April 16th. It is believed their destination is Norval's Pont.

(Signed) R. S. Erskine, Major,
O.C., E.E.R.E. (Vols.)

THE BUILDING TRADES EXHIBITION.

No doubt the Agricultural Hall is an excellent place for military tournaments, cattle shows, and nigger minstrels, but every month or so it clothes itself in a quite different manner, and devotes itself to the development of trade by exhibitions of an industrial nature. We have on several occasions briefly noticed these market shows, but we think that with the exception of the Electric Tramways Exhibition of last year, we have been to none which wore a more businesslike aspect than the Building Trades Exhibition now in progress. From a purely electrical point of view it may not be commandingly interesting, but there are many things here and there which an electrical visitor ought not to miss. The best way to see what to see is to carefully scan the contents of the official catalogue in advance, and then to go round and weed out the wheat from the chaff of bricks, paints, enamels, drain pipes, &c., which naturally abound. The exhibition comes to a close to-morrow (Saturday), so we need do no more than indicate in a general way some of the things which attracted our notice. Of machinery, &c., for making bricks there is no end, and gas and oil engines by Crossleys, Bilbie, Hobson & Co. (the "Stockport"), and the National Gas Engine Company, Limited ("Improved Otto"), are in evidence.

Mr. Arthur Koppel and Messrs. Orenstein & Koppel both have good showings of their portable railways, and the Dolberg-Griffin portable railways, wagons, and switches are exhibited by Messrs. H. R. Griffin & Co., of Finsbury Square, E.C. The usual electric lighting fittings firms are conspicuous by their absence. This is rather surprising, seeing that so much space is occupied by exhibits devoted to the artistic decoration and general improvement of the interiors of buildings. There is a showing of art metal work by Messrs. E. Worrall & Co., and also by Mr. W. Höfler, of Soho Square.

The Dowsing Radiant Heat Company, Limited, have a neat stand, at which are to be found their luminous electric radiators. By the way, we understand that nine of these radiators have recently given great satisfaction at the Isolation Hospital, Leyton. Hoists, pulley blocks, &c., are shown by the Cranstone Engineering Works, Limited, and the London Hoist and Chain Company, Limited, while Messrs. Clark, Bunnett & Co., Limited, of Queen Street, E.C., exhibit one of their electric passenger lifts with its 8-H.P. motor.

Messrs. Matthews & Yates, Limited, of Swinton, Manchester, have "Cyclone" electric fans driven by their "Swinton" alternate current motors, current being generated by a "Swinton" dynamo. The firm make their own electrical machines for fan driving, and this particular department is extending rapidly. For ventilation purposes on South African war transports the fans were very largely in demand. There are several stands at which wood-working machines are in operation, among others being Messrs. Kirchner & Co.'s show of planing, band saw, and other machines, and that of Messrs. J. Sutcliffe & Son, where various tools are operated by a 4½-H.P. C.C. motor, made by Mr. Hodgson Wright of Halifax. Messrs. J. B. Stone & Co., of Finsbury Pavement, E.C., and Messrs. R. Becker and Co., of Rivington Street, E.C., also have exhibits interesting in the same connection. Messrs. James Keith & Blackman & Co. show their electric fans and other apparatus. Messrs. Fleming, Birkby and Goodall, Limited, of Halifax, exhibit their "Teon," a textile belting for machine driving, also leather-hair and cotton belting, and the Gilbert wood split pulley. Messrs. Joseph Kaye & Sons exhibit various things, including their patent seamless oil cans. Phelps's metal is shown by Phelps's Metal, Limited, Delta metal by the Delta Metal Company, Limited, and a new expanded metal by the New Expanded Metal Company, Limited. Messrs. Meldrum Bros. show their well-known patent furnace, also their regenerative refuse destructor, and a model of that installation, for information regarding which you're told to "Go to Darwen." The Patent Regenerative (Boiler) Furnace Company, of Coleman Street, E.C., have on exhibition their smoke-consuming apparatus applied to the furnace of a Lancashire boiler. Messrs. Ruston, Proctor show steam and oil engines. Messrs. J. C. Broadbent & Co., Ltd, of Redcar Iron Works, Redcar, have a stand, at which their patent slag wool sectional covering for pipes may be seen.

From among the gallery exhibits, the one which will interest electrical engineers, perhaps most of all, is a model of the Temperley coal transporter. Those who have not had an opportunity of witnessing this apparatus in actual practice will be repaid for stopping for a moment or two at the Temperley Transporter Company's stand.

The Armoured Concrete Construction Company, Limited, of Victoria Street, S.W., also exhibit in the gallery their system of underground cable conduits, known as the Slab system, as made by Messrs. Wayss & Freytag, Limited, of Neustadt (Haardt). The construction and composition of the blocks, the bitumous lining, the method of jointing, and the accessories in connection with the complete arrangement of manholes and drawing-in pits, are described in lists which have recently been issued by the Armoured Company, who are the sole manufacturers of the conduits in Great Britain. The system is, we understand, exclusively employed by the German Post Office authorities.

There is a special section of the Exhibition in the minor Hall set apart specially for fire prevention exhibits, in fact, speaking roughly, we should think that a large proportion of the exhibits of the great Hall as well claim some special merit in the prevention of fire. The Conduit and Insulation Company, whose electric wiring system is familiar to everyone in the electrical trade, is strongly in evidence in both halls. The only remaining feature which we need refer to is the section called the "Smoke Abatement Section," situated in the King Edward's Hall. From a mere handful of exhibits we select that of Mr. Edwin Cole. His patent automatic furnace door has been adopted for the electric light station at the Post Office in Aldersgate Street, and by the St. James's and Pall Mall Electric Light Company, with considerable success. Engineers who are interested in the problem (and who is not?) should give Mr. Cole a call.

DIFFERENTIAL GALVANOMETER AND ALTERNATE CURRENT MEASUREMENTS.

The discussion on Mr. C. W. S. Crawley's paper "On the Use of the Differential Galvanometer," and Mr. Albert Campbell's paper "On Test Room Methods of Alternate Current Measurement," at the Institution of Electrical Engineers on Thursday of last week, was hardly worthy of the matter put before the meeting, but papers on testing are only appreciated when their contents are digested and actually employed in the laboratory. Mr. Crawley's reply to the discussion was a modest reminder that to Heaviside was due the credit of suggesting the use of the differential galvanometer in the manner he had used it. We think, however, that while Tait, Heaviside, and Swinburne, are each entitled to credit when this instrument is mentioned, to Mr. Crawley must be given the thanks of those who have to work with fixed resistances. The text books usually give the method for comparison between one fixed and one variable resistance, and in our own columns some 14 years ago Mr. Swinburne describes this use in full detail.* The standard resistance consisted of a bar, graduated empirically, along which the galvanometer leads were slid until the

* Electrical Review, Vol. xx., p. 396, April 29th, 1887.

galvanometer was balanced. Mr. Crawley, on the other hand, extends the method to coil or strap resistances with fixed potential terminals, and has done for the differential galvanometer what Latimer Clark did for the Poggendorff compensation method of comparing E.M.Fs. when he devised the potentiometer, or Lord Kelvin achieved when he improved the Wheatstone bridge by adding the bisected conjugate conductors to eliminate contact errors at the junctions of the quadrilateral.

Mr. Glazebrook owned to great interest in both the papers, and particularly in the thermal bridge arrangement of Mr. Campbell.* This was the product of very great ingenuity, and should be of use in research. It was of considerable importance to know how uniformly the curves given in the paper were repeated, and whether they depended upon surroundings, also whether the surface of the nickel altered and affected uniform and regular records. Another question was how the instrument was standardised as a thermal measurer of current. Mr. Glazebrook believed that in the Reichsanstalt at Berlin they were using the differential galvanometer in a similar manner to Mr. Crawley's method. This use solved the very difficult problem of rapidly and easily reproducing low-resistance standards.

Mr. A. P. Trotter had not had an opportunity of trying any of the methods described by Mr. Campbell, but they appeared most promising. He had used the arrangement shown by Mr. Crawley for some time. Until lately 1 ohm was the smallest resistance measured in the Board of Trade laboratory, but it was common now to have to measure very low standards, such as $\frac{1}{10000}$th ohm to carry 1,000 amperes. With some methods the tests came out wonderfully well, but the trouble was to make sure the current was constant while the testing was going on, and there was a tremendous consumption of current. He had Mr. Crawley's apparatus put up, and found it gave all that he claimed. He gave some particulars of tests on a resistance of 26·6 micro-ohms for 2,000 amperes, checked by stepping down, and results agreed to the last figure. The differential galvanometer became a simultaneous potentiometer. He had used a ratio of 1 to 400, which was pushing the method rather far, although it worked perfectly well. As an example with 1 to 400 and a certain resistance, the deflection was 62° to the left, and with 1 to 370 20° to the right, and 1 to 380 10° to the left; the ·1 per cent. key gave 11° to the left in one case and ½° to the right in another, from which the true ratio was found to be 1 to 377. He hoped a d'Arsonval galvanometer could be made sufficiently sensitive for use with this most valuable method.

Mr. Addenbrooke wrote to express his delight with the ease and simplicity of the working of the method, and referred to another means of comparing low resistances given by Mr. Housman in 1897. With respect to Mr. Campbell's proposals, he had always been afraid of using converters, and at last had got an electrostatic voltmeter for one volt which was free from contact errors.

Mr. C. V. Drysdale protested against the neglect of the wattmeter; all other methods would be unnecessary if people understood alternating current power measurement. All the methods put forward incurred or rendered one liable to errors far in excess of what had to be put up with in the wattmeter method. The modification of the three-voltmeter method made it much less accurate, and he cited the case of a 0·1 power factor where a mistake of 1 per cent. in the readings introduced an error of 26 per cent. With a voltage ratio of 1 to 5 and a similar mistake the error might be 55 per cent. Voltmeter needles took some time to come to rest, and he did not think one could get any shadow of accuracy when testing, say, an alternate current motor with a brake on by such tests. He referred to the errors in wattmeters caused by the inductance of the pressure coil, and stated that he had constructed an instrument in which this source of inaccuracy was reduced to a minimum.

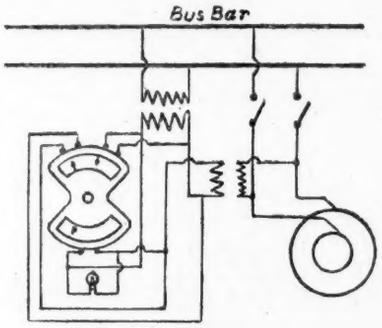
Mr. Campbell replied to the inquiry as to the permanence of nickel wires, by stating that very little change, if any, had been noticed, and the observations so far showed a repetition of results from time to time. Platinum could be used in the thermal bridge conveniently with high temperatures without change, but such an instrument was, after all, only a secondary standard of current. The question with wattmeters was, how was the instrument to be calibrated for inductive loads? While two or three voltmeter methods were not desirable for large loads, one might have to measure the power in the series circuit of a watt-hour meter, and this required something more than the generally available methods. These modifications got one out of many difficulties when one had to transform up or down.

*This, by the way, will be found fully described in the first edition of Prof. J. A. Fleming's "Short Lectures to Electrical Artisans" (1886), on p. 145, but has somehow been forgotten by the younger generation of students. It formed the basis of a voltmeter in the designing of which Mr. Kennelly worked on the suggestion of Mr. Edison, and which was used by the American Edison Companies, prior to the days of the Weston instruments.

CORRESPONDENCE.

The Synchronising of Alternators.

With reference to the latter part of Mr. Fynn's letter in your issue of March 29th, on "The Synchronising of Alternators," would it not be extremely difficult to adjust the voltage of the incoming alternator to the bus bar voltage, as a reading of the former, by means of the phase needle, could only be obtained when its beat is slow; the chances are that on the final synchronising beat either one of the voltages would have varied, necessitating a readjustment of the field, when the phase would be lost.



A scheme very similar to Mr. Fynn's was devised by me some long time ago, overcoming this difficulty by using a combined instrument with three needles.

Of the two needles on the upper scale, see the above figure, one registered the bus bar voltage, and the other the voltage of the incoming machine, whereas the needle on the lower scale indicated the phase relation. In such an instrument, the voltage of the incoming alternator can always be observed. In synchronising, the voltage is so adjusted that the two upper needles coincide, the lower needle then giving the phase. The two upper needles may be painted different colours to distinguish them.

Bernard Hopps.

Rugby, *April 20th*, 1901.

The Maintenance of Batteries.

The interesting article of last week on the maintenance of accumulators has recalled to my mind a suggestion of some time since in connection with cell-testing voltmeters. The importance of regularly recording the voltage of the individual cells of a battery has been rightly insisted upon. I venture to say, however, that the value of this test is considerably nullified by the practice of merely recording the E.M.F. of cells by a cell-testing voltmeter after a discharge or short period of disuse of the battery with the view of ascertaining the degree to which further discharge may be safely carried; and often this is the only test taken as life is too short to bother with hydrometers frequently. Is not this open circuit measurement misleading? Ought not a cell, whose voltage is being tested, to be caused to give current at the same time amounting to at least 20 or 30

per cent. of normal discharging current? To provide for this it is suggested that resistances should be supplied with cell-testing voltmeters. This could be done by suitably disposing thin steel strip, or other high resistance, round the outside of a cell-tester and terminating the strip by the two terminals and using slightly heavier flexible leads. A break may be provided by means of a small copper rod plug uniting a divided strip, enabling the voltmeter to be used separately in the ordinary way when desired; 1·8 or 1·9 volts might be taken as basis for the resistances of which few sizes should suffice for meeting batteries in ordinary use. It would appear that this device might be of service in the case of batteries used for testing purposes in laboratories where it is not always convenient to make the ordinary circuits for discharge when testing voltage of cells.

N. C. W.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending April 24th, 1900.	Value £
Adelaide	14
Alexandria	24
Amsterdam	50
Auckland	101
Bombay	336
,, Teleg. mat.	88
Buenos Ayres	42
,, Teleg. mat.	94
Calcutta	2,062
,, Teleg. wire	655
Callao. Teleg. cable	15,000
Canterbury	11
Cape Town	71
Channel Islands	115
Chinde	12
,, Teleg. mat.	854
Christchurch	28
Colombo	267
Copenhagen. Teleg. wire	121
Durban	101
,, Teleg. apparatus	832
East London	75
Flushing	78
Fremantle	25
,, Teleg. mat.	17
Gibraltar	11
Hamburg	34
,, Teleg. mat.	400
Launceston	200
Madras	181
Mauritius	75
Melbourne	62
,, Teleg. mat.	50
Odessa. Teleg. mat.	80
Ostend	15
Port Chalmers	58
Port Elizabeth	100
Rotterdam. Teleg. mat.	100
St. Vincent. Teleg. cable	163 000
Shanghai	310
Sydney	1,180
Total	£186,878

Week ending April 23rd, 1901.	Value £
Amsterdam	265
Bombay	265
Brisbane. Teleph. cable	1,953
Buenos Ayres	227
,, Teleph. cable	120
Calcutta	4,002
Cape Town	787
,, Teleg mat.	790
Colombo	165
Durban	942
,, Teleph. mat.	149
East London	189
,, Teleg. mat.	117
Fremantle	277
Hamburg	1,080
,, Teleg. mat.	200
Mauritius	15
Melbourne	22
Ostend	366
Paris	126
Port Chalmers	23
Port Elizabeth	743
Stockholm. Teleg. wire	429
Suez. Teleg. mat.	212
Sydney	1,938
Vigo	11
Yokohama	2,285
Zanzibar	11
Total	£17,509

Foreign Goods Transhipped.

		Value £
Colombo.	Elec. mat.	29
Hamburg.	Elec. mat.	100
Total		£129

Bankruptcy Proceedings.—The first meeting of creditors of George William De Tunzelmann, consulting engineer, described as of 6, Penywern Road, Earl's Court, S.W., and 1, Bush Lane, Cannon Street, City, was held before Mr. E. L. Hough, Senior Official Receiver, on 19th inst., the chairman said that the debtor attributed his insolvency to loss through the absconding of a company promoter, the engineers' strike, and the opening of endowed technical colleges. No statement of affairs had been filed, but the unsecured liabilities were estimated at £8,000 or £9,000, the value of the assets being uncertain. No proposal of composition was submitted, and the matter remained in the hands of the Official Receiver. It would be interesting to know how the two latter reasons could possibly have affected the debtor.

Dissolutions, Liquidations, &c.—The liquidators of the New Australian Electric Company are paying a first dividend of £1 per share. The liquidation is due to the entire business having been absorbed by another company.

Creditors of the Hiram S. Maxim Electrical Corporation (in liquidation) must send particulars of their debts, &c., to Mr. M. Devenish, Warnford Court, E.C., by May 25th.

The West Kent Electricity Supply Company meets at 3, Lothbury, E.C., on May 29th, to hear an account of the winding up from Mr. A. E. Jones.

The Spiral Globe, Limited, is winding up voluntarily for purposes of reconstruction, with Mr. L. J. Langmead, of 81, Cannon Street, E.C., as liquidator. The new company is to be known as the Spiralette Lighting Company, Limited.

Books Received.—"Central Electrical Stations," by C. H. Wordingham. 1901. London: Chas. Griffin & Co., Limited. 24s. net.

"Electric Light Cables, and the Distribution of Electricity," by S. A. Russell. London: Whittaker & Co. 10s. 6d.

British Exhibition in St. Petersburg, 1901—02.—Messrs. S. Gorer & Son, of 170, New Bond Street, W., have been appointed official agents for this Exhibition, and all particulars as to freight, insurance, installation, and superintendence of exhibits will be forwarded on application. It is noteworthy that the exhibitors will be limited to manufacturers and producers throughout the British Empire.

Catalogues and Lists.—Messrs. Allan & Adamson, Limited, have issued a March, 1901, list of their portable "Allan" accumulators suitable for a variety of purposes.

Mr. G. C. Thiriet, of 19, Middleton Square, E.C., is the agent for Great Britain for Messrs. M. Taylor & Co., of Paris, who make the "poor gas producer" for gas and oil engines. We have received a small pamphlet from Mr. Thiriet describing the gasogene apparatus, and explaining its construction by the aid of sectional views. A list of installations employing them is added.

The Electrical Company, Limited, has issued a pamphlet in which it describes its dead-beat moving coil and special instruments for measuring insulation resistances on A.C. circuits.

Circular No. 1,044 of the British Westinghouse Company is entitled "Direct Current Railway Generators."

The British Power, Traction, and Lighting Company, Limited, of York, have brought out an excellently illustrated *brochure* of their new 1901 steam automobiles (P.T.L. Gardner-Serpollet).

Mr. A. G. Jeffreys, of 23, Billiter Street, E.C., is circulating illustrated lists describing the Potter mesh separator and superheater made by the Potter Separator Company. The apparatus is stated to be successfully used in connection with a large number of electric light installations in New York.

Messrs. Peto & Radford, Limited, have issued a new price list of their pocket and portable accumulators for reading lamps, jewellery, small lighting purposes, medical work, motor cars, &c.

The General Electric Company, Limited, send us a copy of their April "Electrical Progress Sheet," in which we find details of their curling iron heaters with automatic switch, a quantity of which were supplied to H.M.S. *Ophir* for the Royal tour; also of the patent hydrometer, which should prove useful for the small accumulators used in connection with electrical ignition for motor cars. The list also includes voltmeters and ammeters.

A small pamplet, entitled "Railway Brakes," has been issued by the Westinghouse Company's publishing department. It makes comparisons between the automatic vacuum brake and the Westinghouse automatic brake, and also an improved form of the latter, the Westinghouse quick-acting brake. The statements as to the superiority of the Westinghouse brake are supported by figures quoted from the Board of Trade returns for several years past.

Electric fan motors are detailed in a new list of the Improved Electric Glow Lamp Company, Limited. Desk, ceiling, and ventilating fans for direct and alternating currents are shown by means of a number of capital illustrations.

Messrs. Sperryn & Co., Limited, of Hospital Street Works, Birmingham, are sending out circulars of their standard English electrical accessories, such as lampholders, cut-outs, ceiling roses, switches, bracket arms, and so forth.

Messrs. E. F. Moy's latest circular deals with "Supply Companies' fuses."

Messrs. W. J. Fryer & Co., of Sloane Square, are issuing a price sheet of their patent H.T. safety switch fuses.

A copy of the seventh edition of the illustrated price list of the Universal Electric Supply Company, Limited, which is before us, particularises a variety of apparatus, including battery electric light sets, medical coils, toy motors, dynamos, telephone, magnetic, and other sundries of a like description.

The B.T.H. Co.'s pamphlet, No. 93, deals with D.C., C.C. lighting generators.

Electric Power Bills.—In the House of Commons on Monday, Mr. Rea asked the President of the Board of Trade whether, in view of the multiplication of the private Bills of companies established for the distribution of electrical energy, he intends to promote legislation to give effect to the recommendations of the Joint Committee of 1898 to confer additional powers upon the Board of Trade, to enable the promoters of such Bills to acquire the necessary powers by means of provisional orders instead of by private Acts. Mr. Gerald Balfour replied that the recommendations of the Joint Committee have not been lost sight of, but he was unable to make any definite statement at present.

Electrical Business in the Philippines.—The special correspondent of the *Street Railway Review* in the Philippines has written home upon the very timely topic of "Street Railway Supplies for the Philippines." The article is very much to the point, and seems to be the very thing that is required by the practical business man. We make the following extracts:—

"The erection of street railway lines throughout the richer sections of the islands is of course resulting in a call for cars, rails, ties, bolts, screws, power plants and general materials. There is hardly a place in the country at the present time where railroad contractors can go to purchase what they require. The Spanish attempted to keep a few supply stores in operation in Manila, but these stores carry in stock only general machinery and hardware.

"There ought to be an American agency for street railway cars in Manila with a branch house at Iloilo. Open cars should be provided for passenger traffic, and it would be advisable to have some

of these cars fitted with closed ends as there are seasons of the year when the winds blow severely. The weather is always clear and dry from October and June, and from June to October there is more or less rain.

"It is a matter of notice that in nearly every instance where the Filipinos have subscribed the necessary funds for the building of street railways, electric power plants have been voted for. In many instances the roads are planned to make the entire circuit of an island, as the level of the beaches can be followed, and besides, most of the commercial interests of the islands are at the seaports. Feeders are arranged for in some places to extend to some interior points at which freights may be secured. Electric power is wanted by many of the new companies. The Americans who have the schemes in hand at different points are advising that electrical power plants be put in and the advice is being followed. There are some electrical agencies now established in Manila and one in Iloilo, and these concerns are reaping rich returns. They either arrange for charging a commission for buying the machinery, attending to its shipment to Manila and final delivery to the users, or they buy the outfit complete for cash and resell at a profit. In some instances the power machinery purchased originally for other purposes has been put to use for street railway service. The need of more electrical machinery and steam power plants for railway service is being felt.

"As to the rails for street railroads, some of these at the present time are made of wood, the hardest fibered sorts are being selected and there is an abundance of these in the islands. Some of the English and Russian concerns have of late sent some good types of iron rails here and they sell freely. The construction work on many of the roads is engineered by Americans who naturally require American patterns of rails and fittings.

"Small supplies, such as bolts, screw, wire nails and the like are always in demand. Hardly a machinery or hardware supply store of the country can be relied upon to furnish the desired amount of these wares. The street railway concerns are also in want of iron, steel, brass and other rods. Sheet metal of all kinds is also in very great request. Some of the railroads are making their own cars and they use sheet metal for the tops. The English have supplied considerable sheet metal to the country.

"It seems strange to see newly made native cars being hauled over the lines without any paint on them. The wood is new and clean at first, and the cars look well, for the reason that some of the wood finish is in the hard woods of the islands. The writer remembers seeing some native cars made from mahogany. Rose wood finishes are common. But after a while, the wood gets dry, cracked and soiled and should be painted. But paints are scarce and varnishes are not to be had. American colours and varnishes are wanted here.

"Lubricating oils for car journals are in abundance here but in most cases are inferior. Cheap oils and fats are found here in liberal quantities, while the finer grades of cylinder oils for the engines and for the electrical machinery are scarce. There is certainly a good business to be done here in high grades of lubricating oils by any concern who takes advantage of the chance. Oil cups, oil feeds, regulators and kindred devices should be supplied to the machinery agencies here.

"There are very few street railway car fittings obtainable in the islands. The call is for brass fittings, bell ropes, window glasses, lamps, draperies, upholstering and all that goes toward making street railway cars comfortable for the public traffic.

"The electrical power system's wire is one of the scarce articles. The natives try to make this wire by working down iron rods. After long and tedious labour they work down a few sections of wire and then connect the pieces and string them. Wire is greatly wanted here and some of the wire concerns of America should send considerable to the dealers, for the prices are high and the profits good.

"The best way to reach the different commercial concerns of the various cities and towns of the country is through the commanding officers of the military districts. I know of many officers who want the addresses of American manufacturers of hardware, wire, tools, machinery, paints, &c.

Electric Driving in Railroad Shops.—The New York correspondent of the *American Machinist* has a few words to say regarding the progress of electric driving in Chicago. He says that:—"Factory equipment with electrical transmission is making headway. It is reported that the Lake Shore road has definitely decided to equip its new shops near Cleveland with electricity throughout, making it one of the largest installations of the kind in the country. The Michigan Central is said to be considering the substitution of electricity in their shops at Jackson, Mich.; the Union Pacific is contemplating similar improvements for the Omaha shops, and the Missouri Pacific has commenced work in the same direction. Manufacturing plants are likewise turning in numbers to this transmission system. The Deere & Mansur Company, at Moline, Ill., have bought an electrical equipment of about 500 H.P. for their new shops. The Imperial Wheel Company, of Jackson, Mich., will instal in their new plant at Flint, Mich., a complete electrical transmission plant of about 400 H.P. The Stover Manufacturing Company, of Freeport, Ill., has asked bids for a complete electrical equipment, and in various other lines of manufacture the same activity exists."

Exhibition.—A Naval and Military Exhibition is to be opened at the Crystal Palace in May and continued until September next. There will be a section devoted to inventions, patents and designs connected more or less with naval and military matters, which will show the progress made since the days of the 1851 Exhibition. Particulars of free spaces may be obtained from the technical adviser and manager of the section, Mr. H. C. Braun (Messrs. Braun & Co.), 236—238, Pentonville Road, King's Cross, London.

Germany.—Messrs. Krupp, of Essen, are, it is announced, establishing an electrical galvanising plant at their works at Gaarden.

Grinnell Sprinklers.—Messrs. Dowson, Taylor and Co. have received an order from the Westinghouse Company to protect their new buildings at Trafford Park, Manchester, with Grinnell sprinklers. The installation, when completed, will be a very perfect one, comprising some 10,000 sprinkler heads. We are informed that this is the most important order secured in the United Kingdom for the protection with sprinklers of an electrical engineering concern, and we are glad to see that this matter of fire prevention is attracting greater attention amongst electrical firms in this country.

International Accumulator Competition. — The second international competition of accumulators for automobiles will be held in the laboratory of the Automobile Club of France, 126, Rue du Bois Levallois, on June 1st and following days. The competition will bear principally on the industrial value of the battery. The competition will comprise tests as to the frequency, duration, and nature, of the reparations, and the cost per KW.-hour, bearing in mind as well as the cost, the expense of maintenance and reparation. The tests will last a year. Each battery presented in the competition should furnish practically 120 ampere-hours, and the difference of the potential should not fall below 1·85 volts at the rate of 20 amperes. The batteries will be divided into two categories—those of large capacity and slow charge weighing a maximum of 60 kilos., and those of small capacity and of rapid charge weighing a maximum of 90 kilos.

Simplex Conduits.—The Simplex Steel Conduit Company, Limited, of Birmingham, have recently issued their new price list for 1901. Their system of wiring, which is pretty familiar to

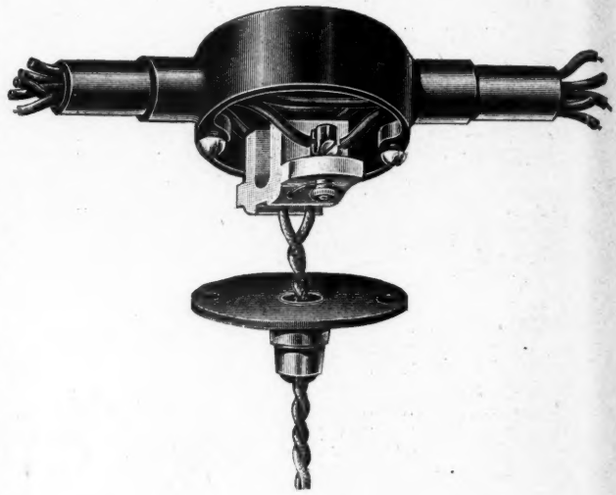


Fig. 1.

the electrical trade, is constantly being developed so as to keep pace with the rapid developments of conduit wiring in this country. The various parts and fittings are illustrated in the catalogue, reference numbers, sizes, and prices being noted in tabulated form. A

Fig. 2.

lengthy list shows some of the more important installations carried out by the company during the past two years, and copies of a number of testimonials are printed. We illustrate above a special pendant fitting (fig. 1) and a subway fitting (fig. 2).

Liverpool Mortgage Insurance Company v. British Electric Works Company.—In the Chancery Division of the High Court of Justice on April 24th, an application was made on behalf of the plaintiffs to Mr. Justice Cozens-Hardy for the appointment of a receiver and manager of the British Electric Works Company, Limited, of Birmingham. Counsel stated that the action was commenced on the previous day in the Liverpool District Registry by the trustees of a debenture trust deed, on the ground that the security had become enforceable. One of the provisions of the trust deed was that the company should keep up its stock in trade to the value of £30,000, and if they did not the security became enforceable. The trustees had certified that the value of the stock in trade was now below £30,000. By Clause 35 of the deed, the trustees were to be at liberty at any time if the security became enforceable to apply to the Court to have the trusts carried into execution, and to ask for the appointment of a receiver and manager. Counsel for the company said he was instructed to consent to the application. There were actions pending by unsecured creditors, and one of these creditors would obtain judgment on Friday next. Mr. Justice Cozens-Hardy said he would appoint a receiver and manager, but he was not to act as manager for more than two months without the further leave of the Court. He should expect the parties to take judgment in the action very soon. Counsel for the plaintiffs stated that he anticipated that judgment might be applied for in about one month.

New Works.—Messrs. Vickers, Sons & Maxim contemplate putting down extensive works for the manufacture of the material required in the carriage-lighting system of the Consolidated Railway Electric Lighting and Equipment Company, the sole rights for which the company have acquired for Europe.

Robertson Lamp Works.—A party of professors and students from the Glasgow University Engineering Society visited the works of the Robertson Lamp Company at Hammersmith last Friday morning, and viewed the various operations. At the close of the visit a vote of thanks was proposed to the directors for granting permission for the visit.

Single-pull Ceiling Switches.—From the electrician's standpoint, says the *Scientific American*, it cannot be denied that the ceiling switch has merits which commend it to every consumer of electricity. It can be placed exactly where it is needed, and it dispenses with the wires which ordinarily run down to a suitable point on a wall. But these obvious merits have been more than offset by the mechanical defects which are unfortunately too often found in ceiling switches. The two unsightly cords which form a part of most switches of this type cannot be manipulated with that case which should be one of the distinguishing features of every electrical appliance. Attention has been drawn to a novel switch made by J. Jones & Son, of 64, Cortlandt Street, Manhattan, New York City, which so far improves upon most ceiling switches, that the difficulties usually presented have been overcome. The improved

switch is a single-pull switch. By drawing downward on a single chain or cord, the circuit is opened or closed. Mechanically considered, the switch consists of a bedplate screwed to the ceiling, which bedplate carries the fixed contact points and the switch arms or blades, one of which is loosely pivoted, and the other mounted on a rock shaft. The rock shaft carries a rock arm and a crank, both of which have partial rotation in opposite directions. The crank is connected by a coiled spring with a cross piece extending between the two switch arms. The rock arm is pivotally connected by means of a link with a crank-pin on a disc actuated by a spring-drum, to which a pull-chain is attached. A pull upon the chain first winds the spring of the drum, then turns the discs, and with it the crank-pin, through one-half a revolution. As the crank-pin turns the link is thrown forward, thereby swinging the rock arm and the crank on the rock shaft in opposite directions. As a result of this movement, the end of the rock arm is made to engage an elbow lever, which assists in swinging the switch arm out, and the crank is made to extend the spring by which it is connected with the cross piece uniting the switch arms. The switch arms partially swung by the elbow lever, and by the strain on the coiled spring, are automatically carried entirely away from the contacts by the action of the extended coil spring. This movement of breaking the circuit is effected with the utmost rapidity. When the pull chain is released, the drum is carried back by its spring without in any way disturbing the disc or the remaining parts. In order to close the circuit, it is necessary merely to pull the chain again. The disc is then made to rotate through the remaining half of its revolution, thereby throwing the rock arm and crank back to their initial positions, rocking the shaft, and extending the coiled spring. When the crank, to which the coiled spring is secured, passes the vertical, the switch is automatically closed by the action of the extended spring. In both making and breaking the circuit the switch arms are first partially swung, and are then automatically actuated by the coiled spring. A careful examination of the device convinces our contemporary that it is both quick and efficient in its operation.

Smoke Prevention.—Furnace doors for smoke prevention purposes are shown at the Building Trades Exhibition. Their object is to admit air above the fire of a boiler furnace. Messrs. Cole & Austin state that these perforated doors can be regulated for air admission, and are arranged to prevent heat radiation to the firehole. They are correct in principle, and where other conditions are favourable, will prevent smoke and will improve furnaces which are not well designed. The door is easily adapted to any furnace. The Regenerative Furnace Company also show their system of steam blown air jets which enter the mass of gases as they pass over the bridge and help to burn them by the aid of the introduced oxygen. The air jets issue from holes in a series of vertical hollow columns which are easily and simply arranged, and are correctly placed to secure the end aimed at. They should also give considerable assistance to the draught. The circular before us does not state the material of the air channels exposed in the fair way of all the furnace heat, but if of cast-iron, we should feel a serious doubt of their durability.

Steel.—The *Daily Chronicle* New York correspondent says that Messrs. Jessop & Sons, iron and steel manufacturers, of Sheffield, have purchased 37 acres at Washington to erect a plant, for objects which have already been briefly mentioned in the Electrical Review.

There is a press report to the effect that all the South Russian metal works have arranged to form themselves into a trust, and 63 different firms have agreed to throw in their lot.

The New York papers are putting it about that American steel works have got so much of their own to do that they don't care a jot for foreign orders. Prices are going up. "All the large rail mills are filled to the utmost capacity. Members of the United States Steel Corporation say that there is sufficient business to keep the rail plants busy until November 1st. No attention is being paid to the foreign orders for rails, as the manufacturers are too much taxed with home orders." We hope English tramway authorities will act accordingly, and plump for English stuff. But, perhaps, the Trust has an object in view which we do not care to describe in precise terms.

The Supply of the Westminster Corporation.—At Westminster on 19th inst., says the *Times* report, Mr. Sheil had before him 80 summonses against the Westminster Electric Supply Corporation, Limited, taken out by Messrs. J. R. Cleave & Co., of the Hotel Windsor, Victoria Street, S.W., for wilfully making default in complying with the regulations of the Board of Trade as to the supply of electrical energy. Mr. Horace Avory, K.C., with Mr. Craies, appeared for the prosecution; and Mr. R. W. Wallace, K.C., with whom was Mr. A. B. Shaw, defended. The case for the prosecution was that under the Lighting Order of 1889, Messrs. Cleave & Co., as customers of the defendant corporation, are entitled to an electrical supply at a constant pressure of 100 volts, with no variation exceeding 4 per cent. either way. This provision in the order is, however, greatly qualified by a further regulation relied upon by the defendants, "that no penalties shall be inflicted if default is occasioned by inevitable accident or is of so unimportant a character as not materially to affect the value of the supply." Under this last clause Mr. Sheil dismissed several summonses, though Messrs. Cleave had given evidence that their current so fluctuated beyond the limits allowed that their lamps were either blackened or burnt out by over-voltage or gave only half their proper illumination through deficient pressure. Mr. Avory then said he would select a summons for a day in last October, when the voltage was over 110 for 40 minutes, and no fewer than 17 lamps at the hotel were broken and several fuses burnt. Evidence being given to bear this out, Mr. Sheil asked questions as to the length of duration of the current variation, remarking that he should not hold short changes of, say, five or six minutes as offences to be penalised. Mr. Avory: Surely it is for the Legislature to say that. They say nothing about the duration of the offences, and,

with great respect, if you are going to read into the Act that the variation must be for a prolonged period, we had better try and go to another Court. Mr. Sheil: I only hold that the brief variations do not materially affect the value of the supply. For the defence of the particular day under review Mr. Wallace relied on "inevitable accident"—an electrical breakdown at the Army and Navy Stores, on the same circuit as the Hotel Windsor. Mr. Sheil dismissed the summons, as he had done with the others, and suggested the adjournment of the remainder (about 75 summonses). Mr. Avory agreed that it was hardly worth while to go further that day.

Switzerland.—The Neuhausen Aluminium Industrie Gesellschaft, of Neuhausen, Switzerland, is declaring a dividend of 12½ per cent. for last year, as compared with 13 per cent. in 1899.

Trade Announcements.—The Endolithic Manufacturing Company, Limited, inform us that they have adapted their system of lettering to metals, and are now manufacturing address tablets in brass, plated brass, white metals, &c. The lettering can be done either engraved or in relief. They are also making painted and engraved ivorine labels in any colour, or combination of colours. These are in addition to their endolithic ivory and bone labels. The name of the company has been changed to the Endolithic Manufacturing Company, Limited.

We are informed that the Faradian Club has removed from 8 and 10, Charing Cross Road, to new and more commodious premises in the St. Ermin's Hotel, Westminster.

Messrs. Julius Sax & Co., Limited, of 119, Coldharbour Lane, S.E., have removed to 51, Rupert Street, Coventry Street, W.

The Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, have effected a combination of their selling organisations. We understand that by thus combining forces in the field, they are mutually benefitted, inasmuch as the products of the two companies are totally different, and where the product of one is used, the other is likely to be necessary. The product of the Bullock Company consists of a complete line of direct and alternating current machines, from a ½-H.P. motor to a 10,000-KW. generator; controllers of various types and rotary transformers. The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes and single-phase self-starting alternating current motors. The new organisation will be under the management of Mr. E. H. Abadie, formerly sales manager of the Wagner Company.

ELECTRIC LIGHT AND POWER NOTES.

Alfreton.—Last week Mr. A. P. Trotter, inspector from the B. of T., held an inquiry into the application of the Urban Council for a prov. order to supply electricity to the town for light and power purposes. Mr. C. A. Baker, the Council's electrical expert, put down the cost of the scheme at £13,734, and the annual maintenance charges at £1,498; the probable revenue was £1,500. Mr. J. S. Barnes, the Council's engineer, explained the details of the scheme. Residents in the division opposed the scheme, and Mr. A. A. Campbell Swinton, electrical expert, said the scheme would result in a deficit to the town.

Arbroath.—Owing to the difficulties in connection with the debt on the gasworks, the T.C. has deferred further steps in the matter of electric lighting for the present. The Council's prov. order expires in August next.

Barnsley.—Mr. H. H. Law, M.I.C.E. inspector of the L.G.B., sat last week to inquire into proposals of the T.C. to borrow £20,000 for the extension of the electric lighting works and plant. The electrical engineer, Mr. Barstow, explained that £28,500 had been already expended, but since supply commenced in February, 1900, the increase in the number of consumers had been so rapid, that extensions were necessary, and tenders had been accepted for the supply and erection of one 300-KW. steam dynamo for £3,450, to be delivered in July next. To cope with the demand during the next two years, it was incumbent on the Corporation to increase the generating works and mains considerably during the ensuing summer. It was estimated that by September 1st, 1902, there would be 380 consumers, with 30,700 lamps. Already 18 consumers of power purposes were taking 100 H.P. The capacity of the present generating plant was 12,500 8-C.P. lamps; an additional generating set would bring the capacity to 22,500 lamps, without reserve.

Barton.—Col. Coke, J.P., on behalf of the L.G.B., held an inquiry last week in respect of the Council's application for sanction to a loan of £5,000 for electric light extension works. It has been decided by the Corporation to fix a new machine in place of one of the small sets, by which the generating power will be of more than double its present capacity, without extension to the present building.

Bo'ness.—A special meeting of the Electric Committee of the T.C. was held last week to consider the proposal of Mr. Purvis, on behalf of Messrs. Crompton & Co., to put an installation of electric light into Bo'ness free of cost to the Council. The proposal was favourably received.

Bristol.—Mr. Goodger, formerly manager of the Waterloo Ironworks, Poole, has been appointed resident engineer for the new electric light station. He will superintend the building of the new works and the erection of the machinery.

Dalmatia.—An Italian syndicate is reported to have secured a concession to put down plant to utilise the water-power of the Kerka Falls, in Dalmatia. A large power station will be established at Sebenica.

Dublin.—The latest phase of the Dublin electric lighting scheme is described in the *Irish Daily Independent* thus:—"We understand that a communication has been addressed by the Local Government Board by the Corporation stating that they cannot sanction the application recently made to the Treasury for a loan of £256,000 for the purpose of erecting a power station at the Pigeon House in accordance with the plans prepared by Mr. Hammond until evidence is laid before them to show that the projected works would be capable of providing for the lighting of the newly annexed districts, viz., Clontarf, Drumcondra, Glasnevin, Cabra, and Kilmainham. It will be remembered that when Mr. Hammond's scheme was prepared, the districts in question had not been added to the city area. The Local Government Board, we believe, set out in their letter the fact that, as the recently acquired townships will be liable to the taxation necessary in order to defray the cost of establishment of the lighting system proposed to be created, it is essential to secure that it will be of sufficient magnitude to meet the needs of the entire of the enlarged city. The importance of this proviso may be inferred from the fact that it has already been stated that the lighting of Clontarf alone—leaving aside any question of the provision of electric current for power purposes—would involve the Corporation in an expenditure of upwards of £20,000. We also learn that the Local Government Board in their letter to the Corporation express the astonishment with which they have ascertained that the latter body has already incurred expenditure and obligations which should not have been entered upon until the final sanction of the Board had been given to the proposals of the Municipal Council and at least the first instalment of the suggested loan paid over by the Treasury. The Board express the opinion that the incurring of the expenditure referred to is wholly illegal and *ultra vires*."

Messrs. J. and W. Stewart, of Belfast, electrical engineers and contractors, have brought an action against the *Irish Independent* Company, Limited, for alleged libel contained in articles and correspondence published in the *Independent* and the *Evening Herald* last March, objecting to the acceptance of their tender on the ground that they employed no trades unionists, and did not adhere to the fair wages resolution of the United Trades Council.

Electric Lighting Areas (London).—Before one of the examiners of Standing Order proofs of the House of Commons on 22nd inst., Mr Cripps (of Messrs. Dyson & Co.) complained that the standing orders relating to notices had not been complied with in the case of the Electric Lighting (London) Bill. Speaking for Mr. G. C. Martin and Mr. Edwin S. Piggott, he submitted that the effect of Clause 5 of the Bill would be to enable the promoters to acquire compulsorily certain mains and works belonging to electric lighting companies, at a price to be determined by a single arbitrator "on the actual value of the mains and works taken over." The notices in the *London Gazette* did not state that such a provision would be proposed, and he therefore maintained that the standing orders had not been complied with. It was stated (says the *Times*) that the Bill would affect small detached areas of supply of the electric lighting companies outside the limits of the new municipal bodies, this being especially the case in Chelsea. The County of London and Brush Provincial Electric Lighting Company, Limited, the Chelsea Electricity Supply Company, the London Electric Supply Corporation, the Metropolitan Electric Supply Company, Limited, the City of London Electric Lighting Company, Limited, and the Blackheath and Greenwich District Electric Lighting Company, Limited, would be affected. The examiner said the Bill was for the purpose of making adjustments in the areas which had been altered by the new Municipal Act. It appeared to him that the provision for the taking over of detached parts of works and materials was a necessary consequence of that Act. Whether the scheme was a fair or an unfair one was a question of evidence which he could not go into. He found that the standing orders had been complied with.

Electric Power Bills.—The Derbyshire and Notts Electric Power Bill was expected to come before the House of Commons' Committee on Wednesday. There is considerable opposition to the Bill from public authorities in both counties affected, though the promoters are not quite without friends, the Clowne District Council, for example, petitioning in their favour.

Fakenham.—The poll as to the adoption of the scheme for lighting Fakenham by electricity has resulted in the rejection of the proposal.

Glasgow.—The Corporation has agreed to supply electricity in the burgh of Kinning Park at the same price as in Glasgow, and to pay for the cost of the prov. order.

Goole.—The B. of T. has granted the electric lighting prov. order applied for by the T.C.

Ham.—At a meeting of the District Council, a letter was read from the Board of Trade to the effect that they had decided to

grant the orders applied for by the local authorities, and that the application made by the Richmond (Surrey) Electric Light and Power Company would not be proceeded with.

Hampton (Middlesex).—The application of the U.D.C. for a P.O. has been sanctioned by the Board of Trade.

Hanley.—At the Police Court on 17th inst., W. A. Martin, until recently an electric lamp cleaner and fitter to the Corporation, and S. Askey, fishmonger, were charged with an offence under the Electric Lighting Act, 1882, and the Gasworks Clauses Act, of 1847. Mr. J. Challinor, the town clerk, prosecuted. The town clerk stated that Askey, who used the electric light, desired to have more lamps at his shop, and asked Martin to do the extensions. Martin had no authority to do this kind of work, and he did it in such a manner as to make himself and Askey liable to a penalty. Martin put six new lights in Askey's shop, and to supply four of them made a connection with the line from the main before it reached the meter, so that the electricity consumed by those four was not registered by the meter. The offence was admitted, and Mr. E. A. Paine pleaded that Martin was an unskilled man, and acted through ignorance. He had been dismissed for doing this work, for which it appeared, however, he had charged Askey. He was fined 40s. and costs. On behalf of Askey, who admitted the facts, it was pleaded that he was in utter ignorance of what the man was doing. He was fined a like amount on undertaking to pay 15s. for the electricity used.

India.—Messrs. John Fleming & Co., of Bombay, have received a contract from the Indian Government to supply the electric lighting for the Boer prisoners' huts at Ahmedagar.

Islington.—It is proposed to test two different kinds of stoker at the electricity works, those selected being the "Under Feed" and the American Blower Company's stoker. If the results are satisfactory, it is proposed to purchase them at a cost of about £250 each. The matter came before the Council last week, on the recommendation of the Lighting Committee, but had to be deferred because it was objected that the recommendation did not comply with the standing orders!

Kendal.—On the 17th inst. an inquiry was conducted by Mr. K. M. North, M.I.C.E., L.G.B. inspector, on the application made by the Corporation for powers to borrow the sum of £14,000 for the purpose of an electric lighting scheme for the town. Mr. A. H. Dykes, of Messrs. Handcock & Dykes, consulting engineers, Westminster, who are the engineers to the scheme, attended and explained the proposals. There was no opposition.

Leeds.—The City Council having made application to the L.G.B. for sanction to borrow £510,500 for purposes of electric lighting, a public inquiry was held on 18th inst., by Mr. H. H. Law, M.Inst.C.E., an inspector appointed by the Board. The Council's scheme includes the extension of the present works in Whitehall Road, the installation of engines and dynamos, the introduction of new plant, and the laying of mains in various parts of the city. The number of units sold in the year ended March 20th, 1901, was 2,520,414, an increase of over 500,000, or more than 25 per cent. on the preceding year. The number of lamps was 132,293, an increase of 26,000 on last year. The profit this year was £20,884. Mr. Dickinson, manager of the works, said that between September 1st, 1898, and September 29th, 1900, the Corporation had expended upon existing works £141,929 13s. 11d., which had been met by bank overdraft. The sum which it was proposed to expend on new buildings and plant was £160,000.

London.—Stepney.—It is stated that the County of London and Brush Provincial Electric Lighting Company, which obtained a provisional order to supply electricity within the areas of the late Limehouse District Board of Works and the Vestries of Mile End Old Town and St. George's-in-the-East, but failed to carry out the works in the stipulated time. The authorities subsequently decided to apply for provisional orders to supply electricity within their districts, and their Acts, when obtained, provided that if within six months the Brush Company served upon the local authorities notice showing the amount which they claimed as representing (*a*) the cost of obtaining their provisional order, and (*b*) the cost incurred with the object of affording a supply of electricity, such claim should be met by the authorities in equal parts. The company has served upon the Stepney Borough Council a claim for the sum of £1,248 incurred under heading "*a*," and £20,746 incurred under heading "*b*." It is stated by the *Sun* to be probable that the Council will apply to the Board of Trade to appoint an arbitrator to determine the amount the company is entitled to receive.

Hammersmith.—The Borough Council has decided to apply for a loan of £13,500 for the extension of the electric mains. In his report to the Council, the electrical engineer, Mr. A. H. Preece, suggested a proposal to utilise the Thames water for condensing purposes. The necessary outlay would be close upon £10,000, but Mr. Preece hoped for a large reduction in the consumption of coal, and an ultimate saving to the rates of £2,000 a year. The Council approved of the scheme, and instructed the surveyor to prepare the necessary specifications.

Poplar.—The Guardians are going to spend £13,500 on an electric lighting installation at the union workhouse.

City.—The Tower of London and the Royal Mint are now illuminated by electricity.

Malvern.—A meeting of ratepayers has passed a resolution approving of the proposed municipal electric lighting scheme.

Manchester.—The Electricity Committee of the Corporation last week adopted the estimates for the current year, showing a probable deficit of £5,000. This is attributed to the fact that during the past year cables have been laid far beyond the supply of current obtainable, and consequently for the present this work has produced no revenue. It is anticipated that the deficit will be taken from the reserve fund, which stands at £13,000.

Morley.—Mr. H. H. Law held an inquiry last week on behalf of the L.G.B. with respect to an application by the Corporation for sanction to the borrowing of £7,035 for purposes of electric lighting.

Pokesdown.—The B. of T. has refused the application of an electric light company for a prov. order for the lighting of Pokesdown.

Pontypridd.—The B. of T. has issued a prov. order to the D.C. authorising the Council to supply electricity for all purposes within the district.

Provisional Orders.—Several provisional orders made by the Board of Trade came on on Monday before the Examiners of the House of Commons for proof of compliance with the Standing Orders. This having been given the orders were reported for second reading. They included Abertillery, Briton Ferry, Ebbw Vale, Llandaff and Dinas Powis, Llangollen, Neath and Tredegar.

Russia.—La Société d'Eclairage Electrique de St. Petersburg is now supplying to private consumers current to an equivalent of 183,790 10-c.p. lamps, an increase of 68,591 lamps on the year. In addition, current for street lighting is supplied to an equivalent of 5,084 10-c.p lamps.

Shannon Electric Power Scheme.—The Limerick T.C. has received a letter from the engineer to the Shannon Water and Electric Power Syndicate to the effect that the promoters could not agree to the insertion in the Bill of a clause providing for a flow of at least 3 ft. of water over the sills of the Corporation water works at Clareville. Having already agreed to a basis of 90,000 cubic feet per minute for all other parties concerned. The promoters also declined to alter the price from 2d. to 1½d. per unit, and objected to the electrolysis clause as safeguards were provided, and that clause would be detrimental to raising capital.

Southampton.—The assessment of the Corporation electricity works having been placed by the Guardians at £2,500, the Electricity Committee, who regard the amount as excessive, have decided to appoint Mr. Marshall, rating surveyor, to make a valuation of the works.

Spain.—A central electric lighting station has just been completed in the town of Berge. Water power is utilised, the plant comprising two 160-h.p. horizontal turbines, each coupled up to a 1,000-kw. dynamo. As a reserve, in case the water power should fail at any time, a 160-h.p. vertical steam engine is shortly to be installed.

The finishing touches are being put to a new central electric lighting station in the town of Labashda. It is stated that the whole of the plant is of Spanish manufacture, La Sociedad Maguinista Bilbaina, of Bilbao, having furnished the dynamos.

Teddington.—The B. of T. has granted a prov. order to the U.D.C.

Woking.—After a prolonged agitation the advocates of electric lighting on the U.D.C. have been finally defeated by 9 votes against 7, in favour of gas lighting. The agitation was mainly supported by the representatives of the station ward, which, it was urged, would have to pay the maximum amount for the minimum accommodation, and they asked, as a last resource, that separate tenders for lighting their ward should be obtained both from the gas and electric companies.

Worksop.—The U.D.C. has resolved to apply for leave to borrow £10,000 for electric lighting purposes.

ELECTRIC TRACTION NOTES.

Altrincham to Stretford.—The Barton R.D.C. on Wednesday adopted the resolution of the Flixton Parochial Council, that they do not entertain the proposal to run electric cars through Flixton in connection with the Altrincham to Stretford and through Flixton to Davyhulme scheme.

Batley.—An inquiry was held on April 18th by Major Druitt, R.E., into an application by the T.C. for sanction to borrow £52,451 for the construction and equipment of electric tramways within the borough. The length of the lines will be 7½ miles, and of the amount sought to be borrowed £30,000 is required for the making of the track. The Corporation asked for 30 years in which to repay the loan. There was no opposition.

Bournemouth.—The Corporation is about to spend £250,000 in providing electric tramways in the borough and the new districts to be added next November.

Bilston.—With respect to the reconstruction and electrical equipment of the tram line it has been decided by the Council that:—

The full width between the rails and 1 ft. 6 in. on each side thereof of each of the railways, and the approaches to the canal bridge and Great Western bridge in Millfields Road be paved with setts or wood blocks. The setts to be Mount Sorrell or similar stone, but the approaches to the canal and railway bridges, and from Queen Street to Swan Bank, to be a sandstone or Pwllhelli sett, and opposite places of worship and from the Market House to and opposite to the Town Hall, wood blocks. The setts to be bedded in sand, the joints racked with screened limestone or other chippings, and run full with boiling pitch. The excavation to be a minimum depth of 1 ft. The concrete to extend to the full width of the track and not exceed 6 to 1, and have a minimum depth of 6 in. Toothing not to be allowed, and the whole of the tracks to be properly drained.

The clerk of the Council has been instructed to forward a copy of this decision to the Board of Trade and to the promoters.

Central London Railway.—The Committee appointed to report on the vibration and damage caused thereby to property on the line of the Central London Railway will hear no more witnesses, but will proceed with the preparation of its report.

Mr. J. W. Penfold, the arbitrator appointed to decide the amount of compensation, if any, which shall be paid to the owners of the town house, No. 2, Lancaster Gate, W., in respect to alleged injury to that property by the construction of the Central London Railway, resumed his inquiry on 17th inst., and after hearing further evidence, he reserved his award.

Cowlairs.—The North British Railway Company on 22nd inst. experimented with an electric engine and a train consisting of four carriages, another train of seven carriages, and another of 10 carriages, for working trains up the incline at Cowlairs tunnel.

Cork.—The Cork Tramways Company's extension to Blackrock was inspected by a representative of the B. of T. last week.

Electrical Omnibuses in Germany.—The Lombard-Gerin system of electrical road vehicles, which was shown in operation at the Vincennes Annexe of the Paris Exhibition last year, is about to be practically adopted in Germany, a line of omnibuses being about to start between the town and railway station of Eberswalde. The vehicles, which run on the roads (without rails), take their current from an overhead conductor, similar to that used for trolley tramways. This system was described fully before the British Association last year.

Hull.—A test of the new automatic cut-off apparatus, patented by Messrs. Bostock & Cheetham, which has been erected in Hessle Road, was held on the 15th inst. Mr. Barnard and the members of his staff, together with Messrs. Bostock & Cheetham, and others interested, were present. At a given signal a cable was cut, with the result that the cut-off action automatically responded instantly, and the current was stopped the instant the cable was severed, the two ends of the wires falling "dead" on the roadway, all danger being instantly averted. Within a few minutes the cable was spliced, everything made good, and traffic was resumed with scarcely a break.

The Works Committee will recommend that the salary of Mr. J. M'Combe, the manager of the electric tramways, be increased from £300 to £350 per annum.

Lancashire.—The Earl of Jersey and other Light Railway Commissioners have just conducted an inquiry at the Bolton Town Hall into the expediency of granting applications for the construction of electric tramways or light railways at Clifton (near Manchester), and between Bolton and Darwen. The Bolton and Salford Corporations and other authorities were represented. It was explained with respect to the Clifton scheme that there are at present tramways on the Salford and Pendlebury side and the Bolton and Farnworth side, but that there is 1¼ miles on the main road at Clifton which the present application sought to have united, so that there would be when it was completed a through service between Manchester and Bolton. The Clifton township is a peculiarly isolated district, and it was very desirable that the 3,000 people resident within it should have tramway connection with the two great centres named. There is virtually no opposition, except to matters of detail. Evidence was afterwards called in support of the scheme. By the Bolton, Tavton, and Darwen Light Railway scheme it is proposed to construct an electric line extending a little over nine miles in length, between Bolton and Darwen, thus coupling up the tramway systems already existing at Bolton and Darwen. Over £50,000 is stated to be the estimated cost. As part of the system, a branch line is projected from Blackburn Road to the district of Belmont, which has a population of about 2,000, and various industries, but, up to the present, has been without any communication with the adjoining towns. The scheme generally, except the Belmont length, will, it is stated, be welcomed by everyone, and opposed by none. A considerable amount of evidence was called in favour of the project, but there was some opposition to the Belmont line by the Bolton Corporation and others on the grounds that it would involve trespassing by the public on the reservoir embankment, and that a better route might have been chosen. The Commissioners intimated that they would recommend the Board of Trade to issue an order.

Liverpool.—Another route, known as the "inner belt route," has been formed in connection with the Liverpool electric tramways system. By the service on this new route, passengers can travel from South Castle Street, in the city, as far eastward, on the Old Swan or West Derby route, as Sheil Road. The cars turn into Shiel Road at either end, and passing along this road, return to the city. The route is intended as a relief route for the main routes which it covers for the hours of the day during which the traffic is most heavy. The fare to or from Sheil Road is 1d.

The returns of the tramway traffic, submitted at a meeting of the Tramways Committee of the City Council on Friday afternoon, show that for the fortnight ending April 13th, 3,761,555 passengers were carried by the electric cars compared with 1,502,648 in the corresponding fortnight of 1900. There were 286 electric cars at work during the period. The total receipts for the fortnight were £17,753 14s. 8d., of which £159 17s. 8d. was received from horse-car traffic, seven horse-cars being still employed. The receipts for the corresponding fortnight last year were £14,744 5s. 1d., nearly half of which came from the horse-car service. At the meeting of the Tramways Committee, Mr. E. L. Lloyd said that those enormous figures indicated the imperative duty on the part of the Committee to fully equip themselves to cope with the immense traffic. The utmost efforts must be made to cope with the difficulties that presented themselves in the way of congested traffic. In all probability the best way to lessen the difficulty would be to "short run" their cars on certain routes at certain parts of the day, and to have different termini. He hoped that the difficulties would be removed at no distant date.

Metropolitan Railway and Electric Traction.—The *Engineer* says:—"Nothing seems to have been settled about the adoption of electrical traction engines on the Metropolitan Railway. We are able to state, however, that American interests have captured the Metropolitan District, to the great annoyance, it would seem, of the Metropolitan shareholders. It will be remembered that long since we told our readers that an American electric company had asserted that it would get the work of fitting out the line on the new system if it had to buy the line bodily. This has not occurred, but it seems probable that a sufficient number of shares has been purchased in the open market to give the company a controlling interest."

We give the following statement on the authority of the *Daily Mail*:—

The District Railway has decided to adopt the system of electrical traction that has proved an experimental success on the Manhattan elevated lines in New York, in Chicago, and on other electrical railways. It is hoped that the work will be completed in 18 months, or two years at the latest. There will be no engines and no wires. A generating station will be made at Chelsea, for which the railway has already statutory power to acquire land, and from this station the electrical current will be made to pass along the whole system through a line between each set of rails. It will be picked up into the motor cars of the trains by a sliding shoe. There will be one motor car to each three carriages. The motor cars will not be distinguishable from the other carriages, which will be known as trailers, except for the fact that at one end of them will be a small compartment, in the nature of a guard's van, where the electrical apparatus will be stored. The carriages will be constructed on the corridor principle, and there will be communication from end to end of the train.

Sedgley.—The Electric Tramway Company has intimated to the D.C. their intention of shortly breaking up the road, for the purpose of constructing tramways in accordance with the Dudley Tramway Order. Mr. Lycett said the delay on starting was due to the difficulty in getting rails.

Sheldon.—The D.C. will meet a deputation of the United Kingdom Light Railway and Electrical Syndicate to confer with them as to the proposed putting down of an electric tramway system.

Surrey and Middlesex.—The electric tramways Bill of the London United Tramways, Limited, passed the Examiner on Standing Orders on Friday last. The scheme is estimated to cost £690,000, and consents have been obtained from the Surrey City Council, and the local authorities of Richmond, Barnes, Kingston, Surbiton, Coombe and Malden, Esher and the Dittons, Hampton, Hampton Wick and Ealing. The authorities at East and West Molesey, and Twickenham so far do not consent to the company's scheme. With regard to Molesey, the company have submitted an amended plan, substituting single for certain double lines, and thus allowing, generally, the statutory width outside the lines, but this offer has been rejected on the ground that the Council has definitely decided that the full statutory width must be provided throughout.

Tramway Officials.—Last week the Northern and Midland Counties' Association of Tramway and Light Railway Officials held its first meeting in Sheffield. Mr. Wharam, general manager of the Leeds Corporation tramways, was appointed president, and Mr. Henry Nozley, general manager of the Burnley Corporation tramways is to be the honorary secretary. Mr. A. L. C. Fell, general manager of the Sheffield Corporation tramways, read a paper dealing with the principal points of the Sheffield overhead electric traction tramway system.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—Mr. A. R. Bennett, the telephone engineer, has submitted an estimate for establishing a 2,000-line exchange, made up as follows:—1,890 completed subscribers, 72 public telephone lines, 16 junction lines to branch switch rooms, 10 junction lines to the Post Office, 538 partially completed lines, the area to include Shoreham, Hurstpierpoint and Rottingdean. The method of construction estimated for, is underground in the chief streets, with overhead distributors from fixed points, 3 in. cast-iron pipes to be laid in all streets where the tramway department are not laying them. In very few cases will

the overhead wires cross the tramway routes, they will in most cases go right and left along the houses from distributing points; in all 2,300 miles of metallic circuit will be provided. The instruments will be similar to those being supplied to Glasgow. The estimate is as follows:—

2,080 instruments at 55s. 6d.	£5,772
Conduits, manholes, &c.	9,334
Main and branch cables	9,841
Switchboards	4,000
Overhead wires, poles, &c.	7,950
Junction lines to other towns	2,200
Salaries and engineers' fees	3,325
Miscellaneous	700
	£43,122

The proposed rate is £7 per annum, or £3 10s. and 1d. per call. based on these figures there should be a surplus the first year. At a council meeting held on April 19th the report was received and adopted after considerable discussion, and it was decided to apply for the necessary loan.

The Ascension-Sierra Leone Cable.—A Reuter despatch dated Ascension, April 24th, states that this cable has been completed.

Cape Colony Telegraphs.—A statement of telegraphic traffic and revenue during the year ended February 28th, 1901, is published in the *Cape Gazette*, from which it appears that the number of paid messages was 1,813,241 sent by the public, and 163,647 sent by Government—an increase over the previous year's traffic of 313,333. The total number of Imperial messages was 568,250. The revenue for the year was £213,449 2s., as against £150,764 7s. 5d. for the previous year—making an increase of £62,684 14s. 7d. Of this amount traffic receipts are responsible for £20,942, and private wire rentals, registered addresses, &c., for £35,742.

Overhead Telephone and Trolley Wires.—Considerable attention has lately been called to the danger of persons coming in contact with telephone wires which have fallen across the trolley wires of electric tramways. Messrs. Robert W. Blackwell & Co., Ltd., have recently perfected two new devices for directly earthing a broken trolley wire, or a broken telephone wire which is in contact with a trolley wire, and thus ensuring the passage of sufficient current either to blow the fuse in the junction box or to release the circuit

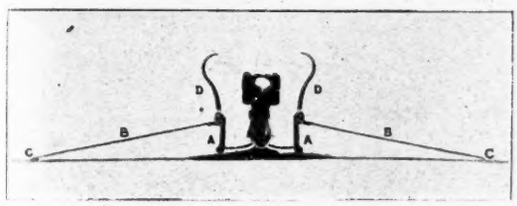


Fig. 1.

breaker at the station. Fig. 1 shows the trolley wire earthing device arranged to suit flexible suspension bracket arm construction. The metal support A is fixed between the shoulder of the insulating bolt and the ear, only taking one or two threads so that standard insulators and ears can be used. A wire B connects the trolley wire at C with the lever D. When the trolley wire breaks the point, C falls and drops the lever on to the bracket arm tube, thus making a good earth through the pole which is connected to the rail. Fig. 2

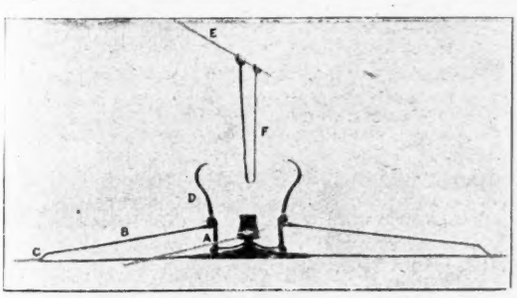


Fig. 2.

shows the same device arranged for span wire construction. An extra span wire E is placed over the span wire supporting the trolley wire. A loop F on this additional span is placed so that the lever of the device makes contact through the loop when the wire breaks. This causes the trolley wire to be earthed through the span E to the pole. Figs. 3 and 4 show the device for earthing telephone wires. Each telephone pole at the points where the wires cross the trolley wires is permanently connected to the rail. A lever C D is fixed to each insulator by means of a clamp B, and the weighted end C is attached to the telephone wire. The stirrup E is connected through the pole to earth. Should the telephone wire break, the weighted end of the lever C drops and brings the other end into contact with the stirrup, thus earthing the broken wire. If the broken telephone wire has come into contact with the trolley wire, sufficient current will flow from the trolley wire through the

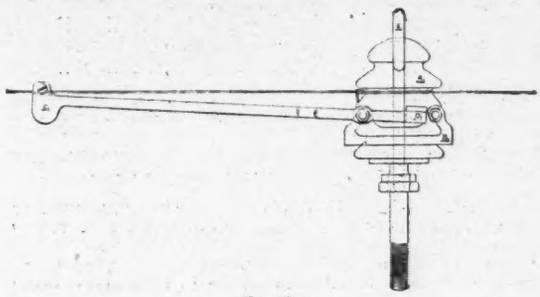


Fig. 3.

telephone wire, either to throw out the circuit breaker or blow the fuse protecting that section of the line. In some cases this current would be sufficient to fuse the telephone wire, which would fall into

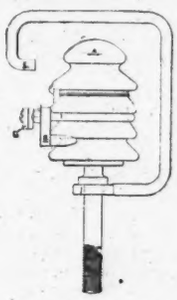


Fig. 4.

the street, and would be perfectly harmless. Any person who accidently came into contact with the fallen wire, even when it was making contact with the trolley wire, would not receive a shock, as the current would take the path of least resistance to earth.

Pacific Cable.—The *Times* says that a landing site for the Pacific cable has been purchased at Kelp Bay, Vancouver Island. One hundred acres have been secured. The work of cleaning the land and erecting buildings will be immediately proceeded with.

Rondebosch Telephones.—The Municipal Council of Rondebosch, near Cape Town, recently discussed a letter which had been received from the Acting Postmaster-General in connection with the suggested modifications in the telephone tariff. The Council were asked (1) whether they were in favour of a reduction of £1 per annum on the Exchange subscription with a day service only; (2) whether they were in favour of retaining the present rate of subscription with a continuous night and day service. The Mayor thought that a Sunday telephone was necessary, especially at present, and the Council agreed to support the Sunday use of telephones.

Southern Nigeria Telegraphs.—In his annual report for 1899—1900, Major Gallwey refers to the "very unsatisfactory system in existence as regards telegraphic communication between the headquarters of the Protectorate and England."

Submarine Cables in War Time.—In the House of Commons on 18th inst. Sir J. Colomb asked the Under-Secretary for Foreign Affairs whether he was yet in a position to give any information concerning matters relating to the cutting of submarine cables in war.

Viscount Cranborne, in reply, said that Article V. of the Naval War Code for the use of the United States navy is worded as follows:—"The following rules are to be followed with regard to submarine telegraphic cables in time of war, irrespective of their ownership:—(*a*) Submarine telegraphic cables between points in the territory of an enemy, or between the territory of the United States and that of an enemy, are subject to such treatment as the necessities of war may require. (*b*) Submarine telegraphic cables between the territory of an enemy and neutral territory may be interrupted within the territorial jurisdiction of the enemy. (*c*) Submarine telegraphic cables between two neutral territories shall be held inviolable and free from interruptions."

Tangier-Oran Cable.—The *Chronicle* correspondent at Tangier says that the French Government is obtaining from the Moorish Government permission to land a cable at Tangier, which will be connected with Oran, in Algeria. The deal has not yet been quite effected, but the French Minister is on the eve of obtaining the concession asked for.

Telegrams to South America.—The *London Gazette* details the reduced rates now chargeable for telegrams to certain countries in South America as follows:—To Argentine Republic, Paraguay, and Uruguay, 4s. 2d., by all routes except *via* France

Teneriffe, Noronha, and Brazilian landlines, by which the charge is 3s. 11d. a word; to Bolivia, Chile, Ecuador, and Peru, 5s. 9d. a word by all routes.

Telegraphic Interruptions and Repairs :—

	Cables.	Interrupted.	Repaired.
Taku-Chefao	.. ..	.. March 29, 1901 ..	..
Singaradja-Macassar	.. ..	.. April 14 ..	..
Latakia-Cyprus	.. ..	.. June 20, 1899 ..	..
Para-Maranham	.. ..	.. March 1, 1900 ..	..
Cayenne-Pinheiro	.. ..	.. April 20, 1901 ..	..
	Landlines :—		
Chinese :—Pekin-Kalgan	.. ..	.. June 14, 1900 ..	..
Tientsin, *via* Shanghai	.. ..	.. June 16, 1900 ..	..
Kalgan-Maimatchin	.. ..	.. June 30, 1900 ..	..

Telephonic Communication in Scandinavia.—A telephone cable has lately been laid between Wedbak, on the Danish coast, and Hildesborg, near Landskrona, Sweden. Telephone lines are also being established between Copenhagen, Malmo, Gothenburg and Christiania, and between Malmo and Stockholm.

The War and the Telegraphs.—In an addendum to his April 2nd dispatch Lord Roberts, referring to Government postal and telegraph services, says :—"These services have had an immense amount of extra work thrown on them, which they have carried out to my entire satisfaction, and my thanks are due to Mr. Somerset French, C.M.G., and his staff, for the very capable manner in which the postal and telegraph services have been worked."

Wireless Telegraphy.—Particulars are to hand of the experiments with wireless telegraphy conducted by Mr. A. W. Sharman on the White Star steamer *Georgic* during a recent outward trip. The system of telegraphy used was that invented by Colonel Henry Montague Hozier, secretary of Lloyd's, and Mr. Nevil Maskelyne, of the Egyptian Hall. The instrument was placed on a table fixed on the main deck of the steamer, and the connecting conductor was secured to the fore and aft stay of the vessel, which stretches between the two masts. Mr. Maskelyne was at Lloyd's station at Browhead, with a set of instruments, to carry out the experiments from the shore. Signals were exchanged until the steamer was 25 miles from Browhead.

In the House of Commons, on 22nd inst., Mr. Gerald Balfour, in reply to Sir J. Leng, said that the Board of Trade had been in communication with the Irish Lights Commissioners on the matter of communication with the Fastnet Rock. The latter are at present considering the best arrangements to be made for housing the additional lightkeepers on the Tuskar and Fastnet lighthouses which will be necessary for the establishment of a system of private signalling. The Marconi International Marine Company has written to the *Times* on the topic as follow :—"We are engaged in putting up a Marconi station on the mainland of the Irish coast, not far from the Fastnet, for the purpose of reporting ships that are fitted with Marconi apparatus. Permit me to add that the Postmaster-General has arranged to receive a deputation of our directors on Friday next, after which we hope to be in a position to inform the shipping companies the terms on which they, when fitted with the Marconi apparatus, will be able to communicate with the shore. The wide range which our station will have, far beyond the Fastnet itself, will render a station on the Fastnet unnecessary."

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—April 27th. The E.L. Committee wants tenders for six water-tube boilers and accessories. See "Official Notices" April 12th.

Ashton-under-Lyne.—April 29th. The Electricity Committee wants tenders for two continuous current generators, each of 250 to 300 H.P., with double acting enclosed engines. See "Official Notices" April 19th.

Battersea.—April 30th. The Council wants tenders for electric pumps and pipe work, river work, pipe and pits, &c. See "Official Notices" March 29th.

Bradford.—The Bradford Corporation are about to advertise for material for the overhead equipment of the Manchester Road Tramway. They have decided to use Cooper's patent joint rails throughout this route.

Bristol.—May 9th. The Electrical Committee wants tenders for steam and other piping, low tension switchboard, and 210-KW. C.C. dynamo. See "Official Notices" to-day.

Cardiff.—April 30th. The Corporation wants tenders for poles, bases, brackets, feeder and section pillars, trolley and other wire, insulators and line suspensions, for electric tramways. See "Official Notices" April 12th.

Christiania.—May 9th. The Secretary of State for Foreign Affairs has received a dispatch from H.M. Consul-General at Christiania, stating that tenders are invited by the Telegraph Department of the Norwegian Government, to be received not later than May 9th, for the supply of copper wire, copper ribbon wire, and tinned soldering wire. Specifications and drawings may be seen daily between 12 and 1 p.m. at the Rigstelegrafstyrelsens Kontor, Christiania.

Copenhagen. — May 4th. The Corporation wants tenders for the supply of a network for a new central station. See "Official Notices" April 12th.

Dundee.—May 1st. The T.C. wants tenders for copper bonds. See "Official Notices" April 19th.

Dundee.—May 11th. The Gas Commissioners want tenders for a 700-H.P. triple expansion steam engine and dynamo. See "Official Notices" to-day.

Dublin.—June 3rd. The Lighting Committee wants tenders for main and sub-station switchboards, transformers, arc lamps and pillars. See "Official Notices" to-day.

Edinburgh.—May 6th. The Council wants tenders for electricity meters. See "Official Notices" to-day.

Fulham.—May 15th. The Council wants tenders for materials for the electric light and dust destructor works. See "Official Notices" to-day.

Germany.—May 1st. The Prussian State Railway Authorities at Munster are inviting tenders until May 1st for the supply of a steam engine and dynamo. Particulars can be obtained from, and tenders are to be sent to, Die General Direction der Königl, Eisenbahnen, Munster.

Great Eastern Railway.—May 14th. The directors want tenders for the supply of stores and materials. There are 23 different sections, including one for telegraph materials. See "Official Notices" April 19th.

Manchester.—May 7th. The Electricity Committee wants tenders for water-tube boilers; plant of 15,000 I.H.P. in generating and sub-stations, comprising steam engines, &c., three-phase generators and motor transformers. See "Official Notices" April 12th.

Middlesbrough.—April 30th. The E.L. Committee wants tenders for a Lancashire boiler, 300-KW. steam dynamo, condensing plant, and piping. See "Official Notices" March 29th.

Middleton.—April 27th. The Corporation invites tenders for the erection of a refuse destructor to work in conjunction with the electricity works. Mr. F. Entwistle, Town Clerk, Town Hall.

Motherwell.—April 29th. The T.C. wants tenders for steam dynamo and switches and piping. See "Official Notices" March 29th.

Motherwell.—May 18th. The E.L. Committee wants tenders for cast-iron lamp columns, arc lamps, switches, fittings, &c.

Newport (Mon.).—May 8th. The Guardians want tenders for completing the electric light installation at their new work house. See "Official Notices" to-day.

Norwich.—May 7th. The Norwich Mutual Telephone Company, Limited, is about to establish a telephone exchange, and invites tenders for cables, wires, pipes, ironwork, poles, insulators, batteries, telephones and other instruments, switchboards, &c., required in connection therewith. See "Official Notices" April 12th.

Partick.—The Council wants tenders for main switchboards and instruments, battery and accessories. See "Official Notices" April 12th.

Portsmouth.—April 30th. The Corporation wants tenders for various works in connection with the establishment of the municipal telephone system :—conduits and cables, copper and other wire, ironwork, insulators, switchboards, batteries, telephone instruments, poles, arms, &c. See "Official Notices" April 12th.

Poplar.—May 1st. The Guardians want tenders for steam, exhaust, and other piping, valves, &c. See "Official Notices" April 5th.

Rochdale.—May 16th. The Corporation wants tenders for two 412-KW. steam dynamos. See "Official Notices" to-day.

Southampton.—April 29th. The Corporation wants tenders for the supply of stores, fittings, &c., required for the electric tramway department during 12 months. Specifications, &c., from the manager at the Tramway Office, Prospect Place, Southampton.

South Lancashire.—May 13th. The S. L. Electric Traction and Power Company wants tenders for 6,250 tons of steel tram rails, 190 tons of fish-plates, also points, crossings and filling pieces. See "Official Notices" to-day.

Spain.—April 28th. The Secretary of State for Foreign Affairs has received dispatches from Madrid stating that tenders are invited by the Municipality of Lopera (Jaen) for the concession of the exclusive right of lighting the town by electricity; by the Spanish post office, to be received not later than May 10th, for a concession for the establishment and working of a telephone system at Denia; and by the Spanish Government, to be received not later than June 3rd, for a concession for working a system of electric tramways at Barcelona, the concession already granted having been annulled.

Stirling.—May 1st. The T.C. wants tenders for extensions to steam, drain and feed pipes and feed heater. See "Official Notices" to-day.

(Continued on page 719.)

WIGAN ELECTRICITY WORKS.

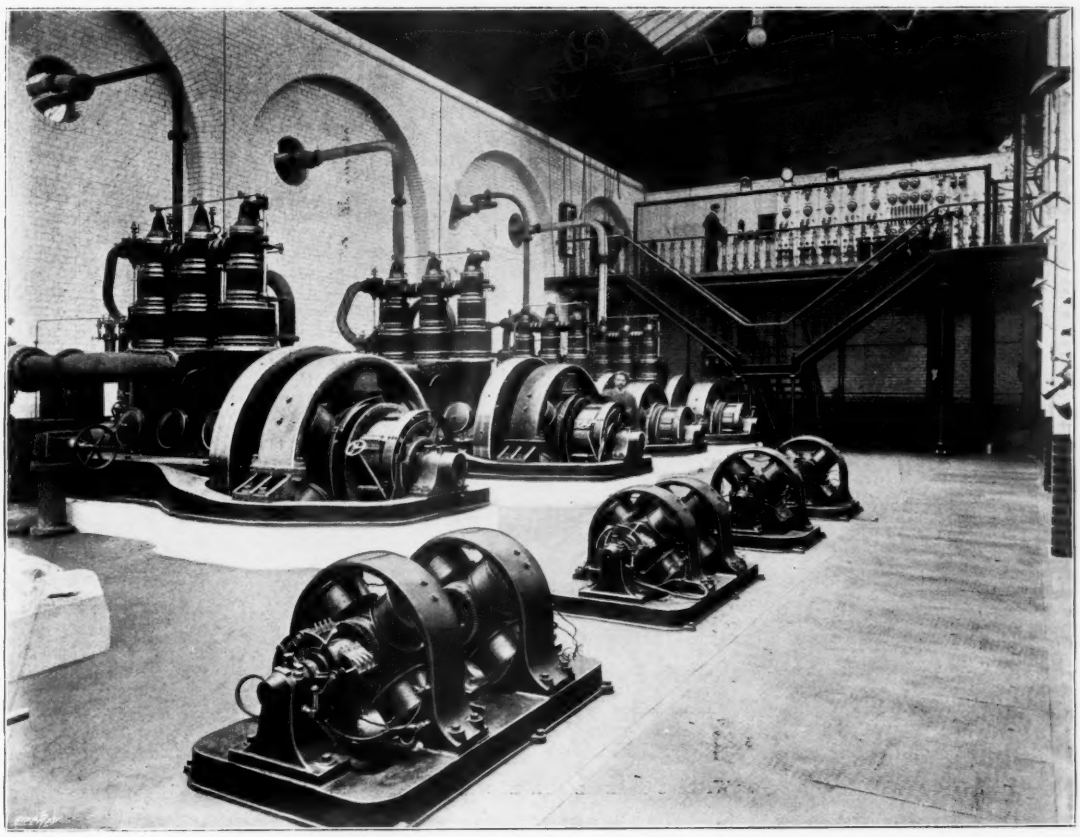
The Corporation of Wigan obtained its provisional order for electric lighting in the year 1890, the Gas Committee having charge of the department. Sub-committees were appointed to consider the matter; in 1895 tenders were obtained on an open specification, and one—that of Messrs. John Fowler & Co.—was accepted, for a high pressure A.C. system. Nothing was actually done, however, until a special Electric Lighting Committee was appointed in 1898. After making inquiries, the committee decided to engage an electrical engineer to design and carry out the work, and early in 1899, Mr. H. Collings Bishop, formerly of Leyton, was appointed borough electrical and tramways engineer. Mr. Bishop at once proceeded to draw up plans and specifications, and application was made to the Local Government Board for leave to borrow £85,000. The usual inquiry was held on July 5th, and the sanction subsequently granted. Owing to the pressing demand, the Corporation found it advisable to lay out £1,000 on a temporary plant, which was got to work in the middle of December, 1899. The whole of this temporary plant, which consisted of a 100 I.H.P. traction engine and boiler, a battery of E.P.S. cells, and about a mile and a half of mains, was laid down within two months of the committee's decision to instal it, the work being done by the Corporation staff under Mr. Collings Bishop.

The plant was fully loaded within two months of the current being turned on, and a number of consumers had to be disappointed.

This small plant was run for about 12 months without a single breakdown of any sort.

The battery was afterwards removed to the permanent works, and formed a part of the battery now to be seen there. The E.P.S. Company performed a very quick piece of work, supplying and erecting the 140 cells required in about four weeks from the date of order.

The provision of a temporary supply in this way is an excellent plan, and might be followed with great advantage in other cases, for it tends to familiarise the public with the reality of the electricity supply, provides a respectable load for the permanent works to start with, and brings in a very desirable revenue during the erection of the latter. Further, this method affords a reliable gauge as to the probable rate of growth of the demand, and may even enable alterations to be made in the plans to provide for larger plant before the work has proceeded very far.



General View of Engine Room.

The work of erecting the buildings (the plans for which were all made to the designs of Mr. Collings Bishop, who also got out all the quantities) and machinery and laying mains was pushed forward rapidly, and supply was commenced from the main station on December 17th last, with a lamp connection of about 5,000.

Meanwhile, a scheme for electric traction, which was set on foot in 1899, was carried out, the sum of £40,000 being borrowed for this purpose; and the first section of the line commenced operations on January 25th. The second section will be running in May of this year.

A number of the streets are already laid with lines, which are owned by the Corporation; they have been leased to a

company, who at present are running steam cars. It is hoped that arrangements will shortly be made by which either the company or the Corporation will run their cars by electric current.

The Corporation now has a Bill in Parliament for several new routes inside and outside the borough.

The direct current three-wire system is used for lighting, with a pressure of 230 volts on consumers' terminals; the dynamos may be used on either lighting or traction, generating in the latter case at 500—550 volts.

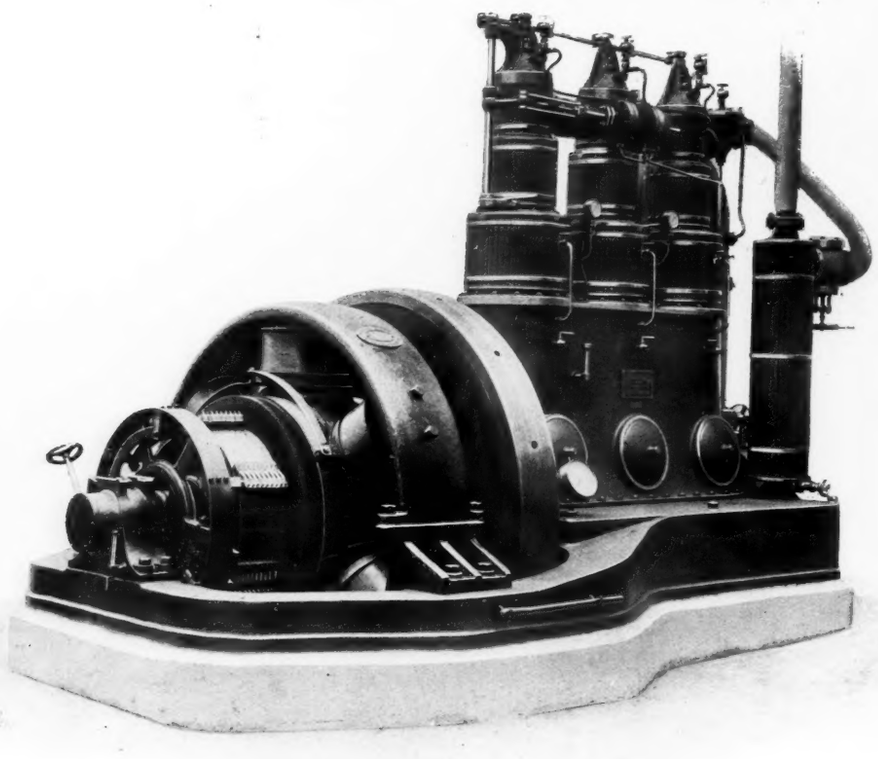
The station is built on a site not far from the centre of the town, and close to the Leeds and Liverpool canal; a private dock has been constructed in connection with the latter, in which coal barges can be unloaded conveniently. A system of coal-handling plant is in course of erection by the Chain Belt Engineering Company, Derby, by means of which the coal will be conveyed from the dock to the bunkers without the intervention of manual labour. The coal will be shovelled from the barges upon a belt conveyer close to the water level in the dock; by the conveyer it will be carried to a hopper; whence an elevator will raise it to a weighing machine on the roof of the coal store, along which it will finally be distributed by a chain conveyer. The relative positions of the dock and coal store and the framework of the conveying plant are shown in one of our views. The belt conveyer and elevator are to be driven by Fuller-Wenström electromotors situated in an underground chamber close to the dock, while the motor which drives the chain conveyer will be fixed in the boiler house.

The latter is adjacent to the coal store and pump room, and is a lofty, well-lighted building. The boilers at present installed are four in number, of the Babcock & Wilcox type, each capable of evaporating 10,000 lbs. of water per hour. They are all equipped with superheaters and chain-grate stokers. There is room for two more boilers, both of which will shortly be erected. The boilers may be supplied with coal, either by means of chutes from the coal bunkers, or by hand stoking from the floor. All the stokers are driven by a Fuller-Wenström motor fixed in the boiler house.

The tower seen on the left-hand of the view referred to above is devoted to water-storage and softening apparatus. There is a large tank on the top of the tower, capable of holding 38,000 gallons. This is filled by means of three large pumps, made by Messrs. J. & G. Weir, and of their latest improved pattern, capable of lifting 60,000 gallons each per hour at 24 double strokes per minute; the water supply is derived from the adjoining canal.

From the uppermost tank the water is delivered either to the condensers in the engine room, or to the Archbutt-Deeley purifying apparatus within the tower. This consists of two tanks, to provide for continuity of supply, and the necessary mixing apparatus for preparing and introducing the softening materials. The process is as follows:—The correct quantity of lime and alkali is placed in a hopper and boiled with water; a steam injector is then put in operation, which draws the water from one of the tanks through a pipe on the mixing platform, and at the same time injects into it a jet of the lime mixture, returning it to the tank from which it came, so that the softening agents are thoroughly diffused through the whole mass of the water to be treated. Finally the valves are altered in such a way as to blow a stream of air through a number of perforated pipes at the bottom of the tank, which sets the whole body of water in commotion, and stirs up the sediment from the bottom of the tank. The result is that, after the stirring-up has ceased, the sediment rapidly falls to the bottom, and carries with it the finely divided precipitate caused by the introduction of the reagent. Thus the softened water is rapidly clarified and rendered fit for use, whereas, if it were left to settle without stirring up the sediment, many hours would be required for the completion of the process.

The feed water for the boilers is drawn from a tank, which is supplied from the settling tanks, by three Weir pumps, two rated at 4,000 gallons per hour, and one at 1,500 gallons. These are provided with duplicate steam and water pipes, and the connections are arranged so that they feed either direct into the boilers or through a Green economiser of 590 tubes, which is fixed in the boiler house. Before entering the economiser the feed water is passed through a heater supplied with the exhaust steam from the auxiliary engines, or, if this is not available, through a live steam feed water heater, so that the water is never sent into



Willans-General Electric Generating Set.

the economiser quite cold. The chimney is 180 ft. in height, 10 ft. inside diameter, and is built into the end wall of the boiler house. The cast-iron cap weighs over 6 tons.

Water-Tower, Dock and Coal Store.

The steam piping, made by Messrs. John Spencer, Limited, of Wednesbury, and erected by Messrs. Crompton and Co., Limited, of Chelmsford, is duplicate from the boilers to the wall of the engine room, the two main ranges running along this wall inside the boiler house. From each main pipe a branch is taken opposite each engine, but the two branches unite after passing through the wall, so that only one pipe goes to the engine. Hopkinson stop valves are used, and the pipes were covered by Haackes, of Liverpool.

The engine room is lined with white enamelled bricks, with a brown dado, and is well lighted from the roof; the floor is paved with wood blocks, and there is a handsome switchboard gallery and staircases at one end, the whole having a decidedly bright and pleasing appearance, as may be gathered from our general view. There are at present four generating sets in position, and two more are on order. Here, we may remark, the advantage of a temporary "nursing" plant is well seen; for the existing plant is of large capacity, but nevertheless extensions are already in progress.

The engines are of the Willans three-crank compound condensing type, with Korting ejector condensers, and are provided with automatic variable expansion valve gear. The exhaust pipes are carried in a trench underground, which also receives the waste from the condensers. The bed plates of the engines are extended to carry the generators, although these are of the multipolar type.

The whole of the generators, boosters, and balancers were made by the General Electric Company (1900), Limited, at their Salford works. There are two generators of 210 KW. each, giving 420 amperes at 460—500 volts for lighting, or 300 amperes at 500—560 volts for traction, and running at 350 revolutions per minute. The other two are rated at 150 KW. each at the same pressures, and run at 380 revolutions per minute.

All the generators are six-polar, compound-wound for traction, and shunt-wound for lighting, with carbon brushes. The series winding is placed by the side of the shunt, close to the pole-tips, which are made slightly wider, circumferentially, at the centre than at the ends of the armature. The field magnet cores are circular in section, and are bolted to the yoke.

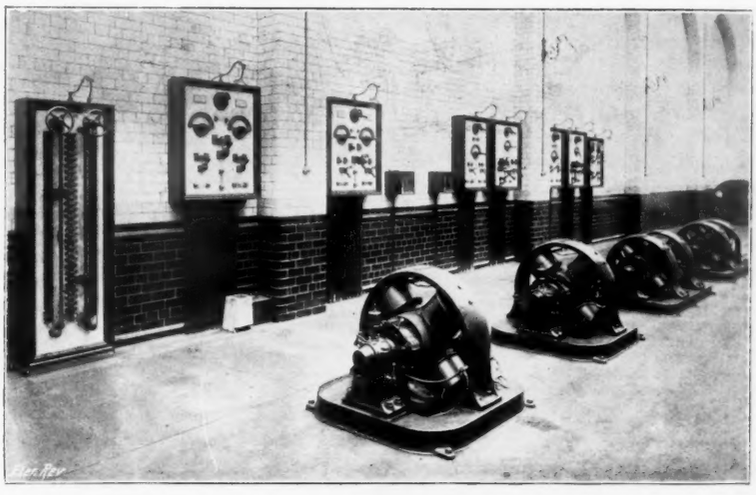
The armatures are, as usual, of the toothed core type, with barrel winding and massive commutators. Heavy flywheel couplings are used, and are bolted to the armature spider, close to the periphery, so that the shaft is not subjected to severe torsional stresses.

We give a separate view of one of the large generating sets, showing these arrangements. The dynamos are capable of withstanding a temporary overload of 25 per cent. if necessary, and run sparklessly and without moving the brushes.

There are two balancers, rated at 50 amperes, 230 volts on each side, and running at 1,050 revolutions per minute. Each of these consists of a double-ended armature, running in a single four-pole field. Two battery-charging motor-boosters are also provided, each consisting of two machines coupled together on a common bedplate. The motor is rated at 28 amperes, 460 volts, and the generator at 100 amperes, 100 volts, at 1,100 revolutions per minute. There are three bearings; the armatures are toothed-core, barrel wound. These four machines are seen in one of our views, which also shows the battery switch gear, and the starting and regulating switchboards for the respective machines. The battery switch is of the vertical type, with chain gear, and was constructed by Messrs. Dorman & Smith. The other switchboards referred to above are of the General Electric Company's make.

The battery consists of 280 cells made by the Electrical Power Storage Company, in wood boxes lined with lead, with a maximum discharge rate of 300 amperes for one hour, and a maximum capacity of 750 ampere-hours. The cells are arranged in a single tier on two floors, in a room immediately behind the regulating switch, seen in our view. The leads from the cells are taken off in a novel way, being carried up into wooden troughs near the ceiling, which are afterwards filled up solid with bitumen. The cables are insulated with vulcanised rubber.

The main switchboards for lighting and traction are



Balancers and Charging Boosters, with Switch Gear.

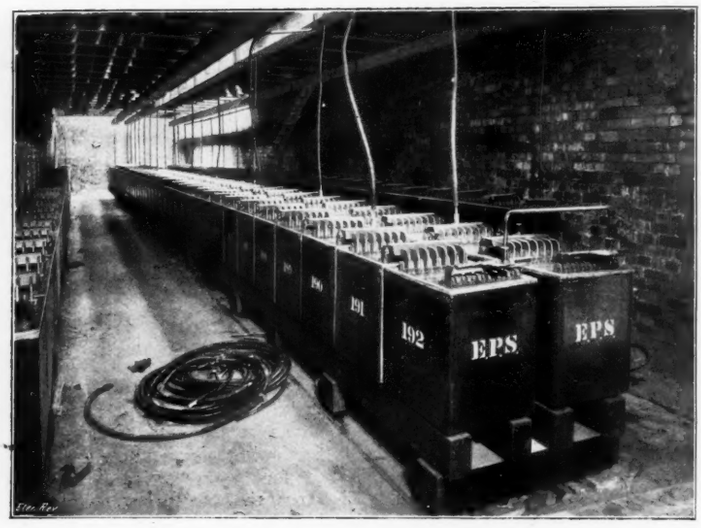
situated on a gallery at one end of the engine room; they were designed by Mr. Collings Bishop, and made by Messrs. Dorman & Smith. There are five dynamo panels, each fitted with an I.T.E. circuit-breaker, Weston ammeter, single-pole double-break positive switch and fuse, three-way throw-over switch to put any dynamo on lighting or traction (coupling up the equaliser bar in the latter case), single-pole double-break negative switch and fuse.

The feeder panel is fitted with 10 positive and 10 negative vertical plug bars, which can be coupled with the single

pair of horizontal bus bars behind the board, and six feeder ammeters. The lower part of the panel is used for balancer ammeters, voltmeters and switches.

The battery panel is equipped with an I.T.E. circuit-breaker, throw-over switch, ammeter, and single-pole positive and negative switches and fuses.

It may be remarked that the outgoing lighting feeders



Storage Battery.

are two-wire only, and that there is only one station pressure; hence the simplicity of the board. Balancing is effected partly by the balancers in the station, partly by balancers situated on the network. Three boosters are provided beneath the switchboard gallery, for varying the pressures on the feeders if necessary; these are shown in one of our views, with the switch gear belonging to them. Each booster is capable of carrying 500 amperes with a boost of 20 volts, and is driven by a motor at 900 revolutions per minute. They are of practically the same size and type as the battery-charging boosters already described. The starting gear is carried on the wall on separate switchboards, beneath which may be seen the graduated resistance switches by means of which the series fields are shunted more or less according to requirements. Other boards are provided to carry the ± feeder fuses and Aron meters.

Returning to the switchboard gallery, the remaining features of the lighting board are two Kelvin voltmeters with a three-pole 12-way feeding point voltmeter switch, Weston voltmeters, and switches for paralleling.

The usual Board of Trade traction panel, made by Messrs. Elliott Bros., is fixed at the end of the lighting board, and a small earth-connection board is mounted at the opposite end of the gallery.

The traction switchboard provides for three feeders, each panel carrying an I.T.E. circuit breaker, ammeter, switch, and Aron watt-hour meter, with a Wurts lightning arrester.

The shunt rheostats for controlling the dynamos are fixed at some distance in front of the board, as shown in our view.

A door at one end of the gallery provides access to a gallery in the boiler house, so that the engineer-in-charge can readily keep an eye on practically the whole station.

The feeders and distributors were supplied by Messrs. W. T. Glover & Co. and the B.I.W. Company, and are drawn into Doulton conduits; there are five concentric lighting feeders of ·5 square inch cross-section, and three traction feeders, each of ·3 square inch. Each feeder runs to a sub-station where all the distributors are collected on one switchboard, these sub-stations form the main distributing centres, and are all connected with the works by private telephones.

The section of the tramways so far constructed is 1¼ miles in length, and was equipped on the overhead trolley system, with bracket-arm suspension and side poles, by the Corporation staff under the supervision of Mr. Collings Bishop. Messrs. Askham Bros. & Wilson supplied the special work for the points and crossings, while the rails were made by the Barrow Hematite Steel Works.

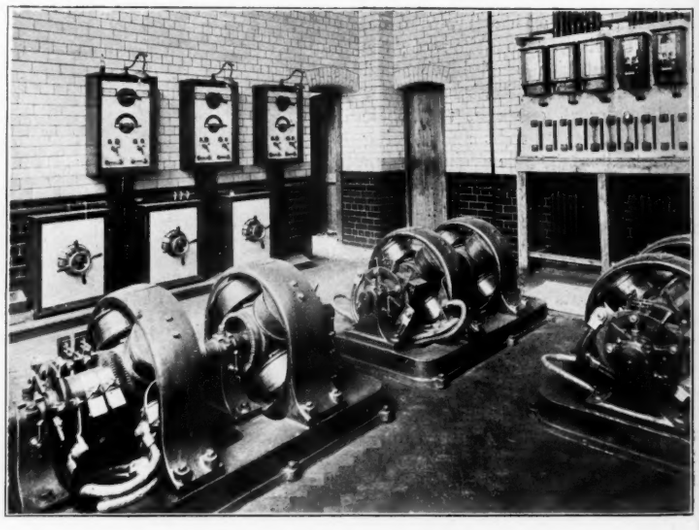
The tramcars are of the double-deck type, and were supplied by Messrs. Dick, Kerr & Co. At present there are 12 cars. One of our views shows a car standing in front of the Market Hall.

The engineer-in-chief and tramway manager is Mr. H. Collings Bishop, with Mr. J. W. Home, as chief assistant, and Mr. J. Slevin, as draughtsman; the engineers-in-charge are Messrs. A. Abrahams, A. Lamb and S. Lees.

There are now about 9,000 lamps connected. A large motor load is rapidly being developed.

In conclusion, we must express our thanks to Mr. Collings Bishop for kindly affording us facilities to photograph the works and to obtain particulars for the preparation of this article.

Shock Fatality.—A correspondent informs us that:—"A carpenter whilst engaged on the roof of a building at Durban, leant over to drive a nail into a facia board, and his head came in contact with the electric lighting wires. As the result of shock, he seized the wires with his hands, and dropped to the ground dead. The remarkable part of the fatality is that these wires are only charged with 200 volts, and a fatality therefrom is inconceivable. Durban is one of the few towns in South Africa where high-tension electric mains are kept underground." In the absence of further details one is inclined to ask whether death actually resulted from the electrical shock, or from the shock sustained by the fall from the roof to the ground, also what was the state of the deceased's heart?



Feeder Boosters and Switch-Gear.

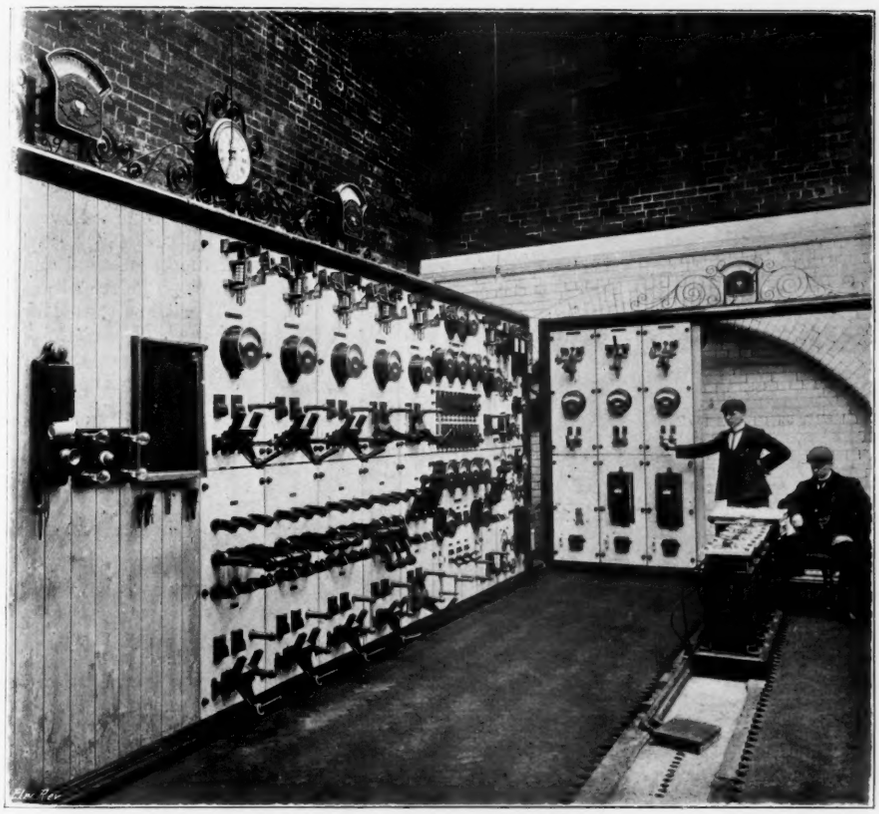
BIRKENHEAD ELECTRIC TRAMWAYS.

We illustrate two of Messrs. Ernest Scott & Mountain's enclosed high speed steam dynamos, which they have supplied in connection with the electric tramways for Birkenhead. These have been erected at the sub-station which the Corporation have recently erected in New Chester Road, adjoining the destructor buildings, and are to supply the electric current for the tramways for the southern portion of the borough.

The plant consists of two of the makers' enclosed compound central valve, self-lubricating high speed steam engines, each being of the following order:— I.H.P., 240; diameter of high-pressure cylinder, 11½ in.; diameter of low-pressure cylinder, 20 in.; stroke, 10 in.; revolutions, 360; steam pressure, 140 lbs., condensed with a vacuum of 24 in.

The engines are each fitted with a governor of the throttling type, fitted with bye-pass, enabling the steam to enter the low pressure cylinder direct in the event of a sudden overload being thrown on the engine. Steam separator with connecting pipes; cocks are also fitted, as well as indicator gear and usual accessories.

The engine is fitted upon a combination bedplate of cast-iron, which is arranged to take the generators, which are of the firm's



Wigan: Lighting and Traction Switchboards.

four-pole type, with slotted drum armatures, each giving an output of 273 amperes at 550 volts.

These dynamos, when running as shunt machines, with all adjusting resistance of the magnets cut-out, will be capable of giving an output E.M.F. of 600 volts at the normal speed.

Each dynamo is complete with two shunt-breaking switches and resistances, two shunt-regulating switches and resistances, and two series-diverting switches for adjusting the strength of the compounding coils on the machines.

Messrs. Scott & Mountain have also just completed four similar sets for the Darlington Corporation, equal to 400 H.P.; three sets for Worksop Corporation, three sets for Worthing Corporation, and three sets for the Hill of Howth Electric Railway, in Ireland.

HIGH SPEED ENGINES.

We illustrate on page 717 a high speed engine, which is made by Messrs. Alley & MacLellan, of the "Sentinel" Engine Works, Polmadie, Glasgow. This engine is of their latest line of patterns of high speed engines, and has been specially designed and constructed to meet the requirements of the best present-day practice in central electricity supply installations. It is of the vertical enclosed, single-acting, self-lubricating type.

As is well known, engines of this type are so arranged that the connecting rod and bearings are in constant thrust during the whole of each and every revolution so that not only does the engine run silently at all loads, but any wear which may occur is automatically taken up by the engine itself. This constant thrust is—like in the Willans engine—obtained by the use of an air buffer cylinder in which compression takes place on the up-stroke and expansion along the same line on the down-stroke without any appreciable loss of power. This method, which was first invented by the late Mr. P. W. Willans, reduces, and, indeed, almost entirely obviates, the necessity for excessive compression in the steam cylinders, by which a considerable portion of the indicator diagram is cut off, with consequent loss of work, also losses through condensation.

The steam is distributed on the well-known Cornish cycle, *i.e.*, after doing work on the top of the H.P. piston during the down-stroke it is displaced to the underside of this piston on the return or up-stroke, to be again discharged into the L.P. cylinders on the next down-stroke.

Owing to the small range of temperature in each cylinder, this system is intrinsically the most economical.

The engine is made with either two cranks set at 180° apart, or three cranks at 120° apart, the latter being adopted for the larger sizes over 200—250 B.H.P., or when the most uniform turning effort with a minimum amount of vibration is desired. The lines of parts are exact duplicates of each other, so all parts are interchangeable.

The valves are of the balanced piston type, and driven direct off eccentrics on the main crankshaft so that all the cylinders and valves are in a line. This may at first sight appear to have the disadvantage of making the engine very long, but it is found that very little extra length is required, as the space is required to allow for the unusually long shaft bearings which Messrs. Alley & MacLellan make a special feature in their engine. We believe that these bearing surfaces are in excess of those in any other high-speed or slow-speed engine in the market. There is no doubt that this is a most desirable feature, as it enables the engine to make very long runs without any appreciable wear, thus saving wear and tear as well as giving greater economy by keeping the clearance spaces practically constant for years.

Messrs. Alley & MacLellan inform us that they have engines which have been running for from five to seven years without the necessity for rebabbitting these bearings or making any adjustment. The automatic lubrication, of course, also helps this considerably.

The lubrication is effected on the well-tried splash method, the cranks, eccentrics, and other revolving parts dipping into the bath of lubricant—oil and water—by which the oil is splashed over all the bearings, which are literally bathed in oil the whole time.

The engine is governed by a powerful shaft governor built direct on to the crankshaft end and controlling an equilibrium throttle valve. It has been found by most careful and exhaustive tests that although with a simple—or non-compound—engine, an automatic expansion governor gives the most economical results for varying loads, yet in a compound engine, and still more in the case of a triple expansion engine, there is very little difference between a throttling and a variable expansion governor so far as steam economy is concerned, while in the matter of close governing one can be made quite as good as the other. Consequently as the throttle valve governor has other advantages over the expansion governor, such as simplicity, less cost, and easy adjustment while running, it has been adopted for all the compound and triple-expansion engines. We are informed that the makers can guarantee that the total variation from full load to no load shall not exceed 2½ per cent. which is quite close enough for most cases, and in special cases where closer governing is required, 1½ per cent. has been obtained without hunting.

The engines are particularly suited for running either non-condensing or condensing, especially under the latter condition, as there is a "distance" piece between the low-pressure cylinders and the crank chamber, thus isolating it, and allowing the piston rod and valve spindle packing glands to be accessible from the exterior while the engine is running. Steam cannot leak down into the

crank chamber to heat it, neither can oil escape from the crank chamber into the low-pressure cylinder exhaust and away to the condenser. The piston rod packings are all of the self-adjusting "floating" metallic type, while the only packing gland on the valve spindle is subject to only exhaust steam, and so soft packing is used, but this gland is also open to the exterior and accessible while running.

Wigan: Electric Tramcar.

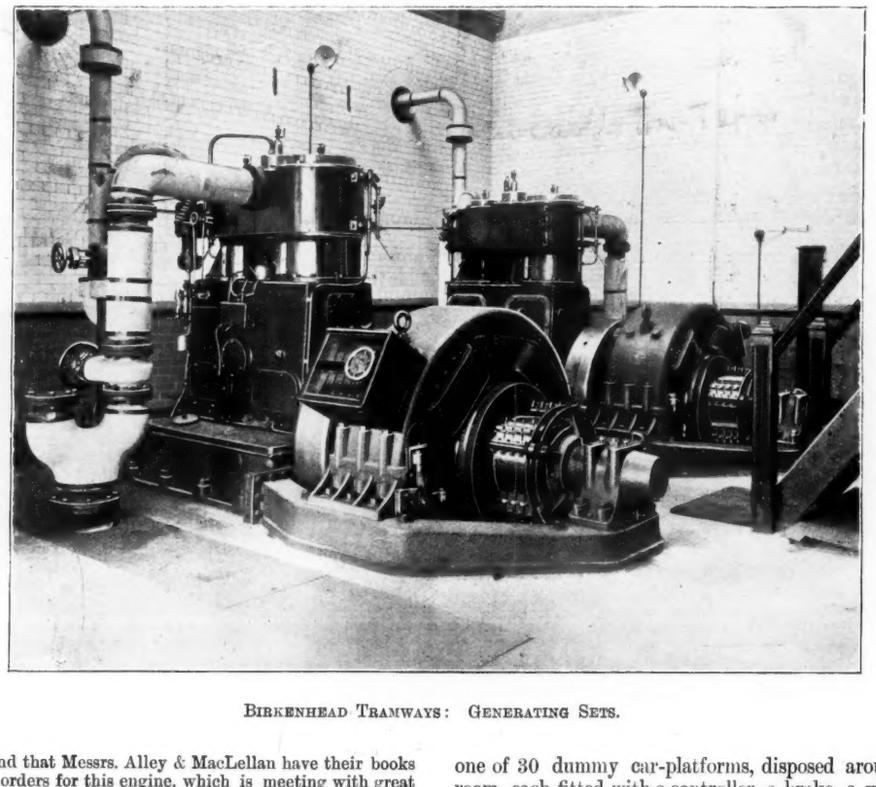
We understand that Messrs. Alley & MacLellan have their books well filled with orders for this engine, which is meeting with great appreciation, and have in hand a large number in various sizes from 50 to 600 B.H.P. both for municipal central electricity supply stations and private installations for both lighting and power. They are putting down additional new testing shop plant, including a 500 B.H.P. Babcock boiler, water measuring tanks, &c., for the testing of larger sets up to 750 B.H.P.

TRAINING SCHOOL FOR STREET-CAR MOTORMEN.*

To the man in the street, the running of a 38-ft. electric car of the underground conduit system, at a fairly high rate of speed, through the most crowded and busy streets of the world, is a matter which involves merely the turning of a controller-handle and of a brake-lever in obedience to the signals given by the conductor. But the man on the car is chosen, not because his work is apparently so simple, but because he has proved his fitness to hold his position by an arduous preliminary training. The heavy cars of our large cities cannot be controlled unless the starting apparatus be properly manipulated, unless the brakes are operated in a certain way, and cannot be safely driven through an interminable stream of wagons unless the motormen have no inconsiderable presence of mind and reasonably good judgment.

In order to train its men to think and act with coolness and precision, the Metropolitan Street Railway Company established a training school some two years ago, in which ambitious recruits were to be systematically taught how to become not only acceptable motormen, but also fairly good electricians, thoroughly familiar with the mechanical and electrical construction of an electric car. The school was the first of its kind ever founded. When it was started by President Vreeland it was scoffed at; but the best proof of its success is to be found in the fact that the street railway companies of the largest cities have followed the example of the New York company.

Before he is admitted to this training school, the applicant is examined by a physician. If his eyes be weak, or if he be not sufficiently robust, he never even sees the training school. The applicant who has successfully passed the physical examination is admitted to the school, and is assigned to one of 30 dummy car-platforms, disposed around the class-room, each fitted with a controller, a brake, a ground-switch,



Birkenhead Tramways: Generating Sets.

* *Scientific American.*

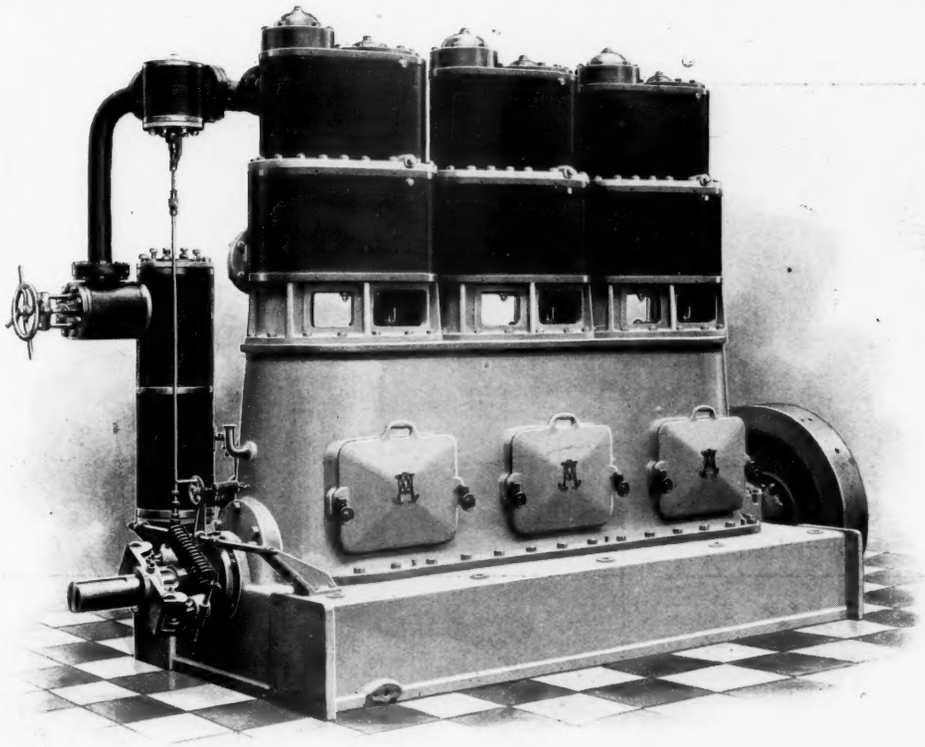
and a fuse box. He is given a book of rules—his electric-car gospel—which he must learn as thoroughly as he once learned his forgotten catechism and the Ten Commandments. The breaking of one of these rules is a sin for which almost any punishment may be meted out. But, of all offences, the most heinous is the neglect to remove the handles of the controller upon leaving the car. "Never leave the car platform for an instant without removing the handles of the controller," is so thoroughly and persistently dinned into the embryo motorman's ears that the rule is followed in the end almost instinctively. Even the men who are tolerated in the school merely because they will not be convinced of their unfitness, never leave the dummy platform with the controller handles in place, although as a ruse they may be called by the instructor to his desk to receive some paltry information.

During the few days passed on the dummy platform, the motorman is taught how to start his imaginary car without hurling the passengers from their seats, and how to stop gradually under ordinary circumstances, and suddenly in a case of emergency. The advisability of turning the controller-handle one contact point at a time, so that the power is applied gradually, is forcibly impressed upon him. In order that he may obey the signals of the conductor, the schoolmaster conveys his orders largely by means of an ordinary car bell.

When he has learnt the rudiments of his calling, the pupil is taught something of the mysteries of electricity. He is taken to the classroom controller, the casing of which is open, so that all who have eyes may see how it is constructed, and the meaning of each contact point, each resistance, is clearly explained. He is taught how to cut out the disabled motor of a car from the controller, and how to manipulate the reversing lever. The terms "multiple" and "series" are defined, not only in unmistakable words, but objectively by means of the controller and the motors.

For this purpose the classroom is equipped with an operative skeleton car, jacked up from the floor so that its wheels may spin with even more freedom than they would on the road. At this period the motorman enters upon the most difficult part of his education. On the road he must be able not only to run his car in a manner which will be a credit to his teaching, but he must also be able to locate open circuits whenever occasion may require. Accidents of all kinds may happen, and the pupil must be able to cope with them before he is graduated. Each man in turn is placed on the platform of the skeleton car, is instructed practically how to operate the apparatus of which he has charge, and how to locate open circuits on a "dead" car, as it is called in road parlance. If, after having been brought to a stop, the car refuses to move when the current is turned on, the motorman knows that something must be amiss. In accordance with the teaching of the instructor, he orders the conductor—usually another pupil—to switch on the lights. When the glow within the car shows that current is at hand, the motorman steps from his platform and examines the overhead switches on both ends of the car, not, however, without removing his handles. Should the switch handles be in proper position he inspects the fuse boxes. If he finds that a fuse has been burnt out he proceeds to the ground switches to cut off the current, then inserts a new fuse, replaces the ground switches, mounts his platform again, and starts the car. But if the fuses be intact the motorman is instructed to cut out the motors in succession from the controller in order to ascertain which motor is defective. Should the lamps fail to light he examines the ground switches. If they be properly set and the headway short, he knows that nothing can be done, and that the following car must push him to the terminus. But if the headway be sufficient he continues his inspection. Entering the car he lifts a trap-door and examines the leads of the plough by which the current is fed to the motors. If the circuit be open at the regular connections the leads are replaced in position; but if they be properly connected, then the motorman knows that some injury has been sustained which he cannot repair and that his car must be pushed to the stable. This instruction in making repairs is accompanied by striking illustrations of the consequences of the motorman's breach of the inflexible rule which requires him never to leave the car platform without removing the controller handles. Either the instructor or an advanced pupil plays the part of an excitable, forgetful motorman—the man who, when he finds that his car will not start, leaves his controller handle perhaps on the sixth or ninth point, frantically rushes off to renew a burnt fuse or turn a switch handle to its proper position, and then suddenly finds himself standing alone with his car speeding away so rapidly that it cannot be easily overtaken.

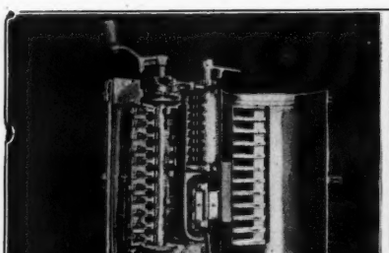
When a car is disabled by an open circuit, and the brakes fail to arrest the car, the motorman is instructed to pull the reversing lever toward him, and then to turn the controller



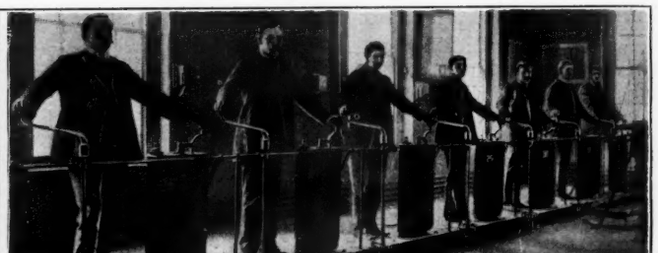
Alley & MacLellan's High-speed Engine.

handle to the sixth point. Thus the motors are placed in multiple and converted into dynamos, sufficient power being generated to stop the car almost immediately. If an emergency stop be necessary, the brake is released, the power is reversed, the controller handle turned to the first point, and sand applied to the rails. Should a fuse or automatic switch car, the reversing being left in the forward position, since the car is already travelling backward.

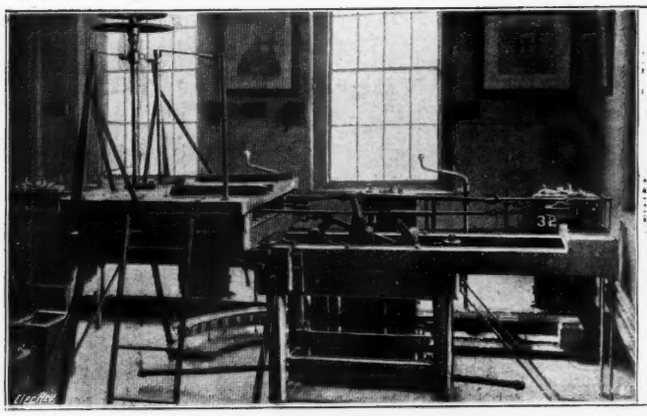
The skeleton car is provided with the usual resistance panels, raised, however, so that they can be readily seen, and fitted with lamps which clearly indicate when the resistance is partially or entirely cut in or out of the circuit. By means



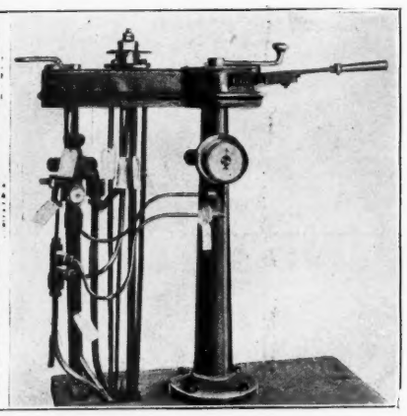
Electric Car Controller.



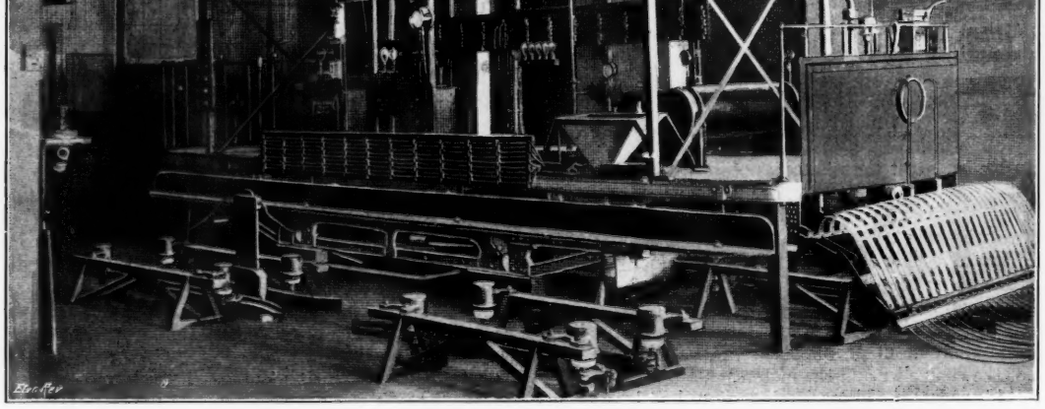
Brake and Controller Instruction.



Cable Car Grip.



Compressed Air Car Controlling Gear



Electric Car and Section of Feeder Rails.

TRAINING SCHOOL FOR STREET-CAR MOTORMEN.

be blown out, the controller handle is moved to the sixth or ninth point, whereby the car is stopped in the manner already described. The motorman must also learn that, when on a heavy grade, an open circuit requires his attention, and the brake fails to hold his car, he has only to turn the controller handle to the sixth or ninth point to stop the of these resistance lamps, the controller and wiring charts, the men are taught that with the controller handle on the first point, the 1,550-volt current furnished by the power house passes through all the resistance; that on the second point, one-quarter of the resistance is cut out; that on the third point, one-half the resistance is cut out; and that

finally, when the fifth point is reached, the motors are running in series with all resistance out. The transition from the fifth to the sixth point connects the motors in multiple, the controller handle passing over three unmarked transition points. The motorman is instructed to make this transition rapidly, so that the motors may sustain no injury from the change to multiple. On the first transition point one-quarter of the resistance is cut in; on the second transition point three-quarters of the resistance is in the circuit, the motors still being in series. On the third transition point, motor No. 2 is dropped out of the circuit. On the sixth point both motors are in multiple with three-quarters of the resistance in the circuit. On the seventh point one-half of the resistance is in the circuit; and on the ninth point the resistance is out of the circuit, both motors running under full speed in multiple.

The training which the motorman receives on the skeleton car is supplemented by lectures on the method of crossing avenues and streets through which other cars travel. For classroom demonstration two sets of channel rails are used, separated any desired distance, to represent the breach in the underground conductor. The schoolmaster constantly reiterates the necessity of shutting off the power at the point indicated by long white marks on the road, and of "floating" across the break. The consequences of turning off the power without sufficient headway are shown by means of a plough used in connection with the channel rails.

When the applicant has learnt in the school all that he need know, he must pass through a post-graduate course on the road under the guidance of an expert motorman before he is permitted to don the blue uniform which is his diploma, and to mount the platform of his own car. If the road practice prove that he has not fully grasped all that the instructor has impressed upon him, he is either sent back to the class-room, provided there is still hope for him, or summarily dismissed without ever entering the service of the company. The road is the crucial test which the training-school graduate must withstand. There all his faults and all his virtues glaringly exposed are carefully observed by the chief instructor; and there the electric-car career of many an applicant ends.

This article has been confined to the training of the electric-car motorman. But the school is also equipped with the dummy platform of an air-motor car, and with a cable-grip. The air-motor car is controlled with more difficulty than a locomotive; and for that reason not more than 10 per cent. of the training-school pupils are capable of manipulating its complex starting apparatus. Nowadays the cable-car grip is rarely used. In 10 or 15 years the tall model which now stands in the class-room and towers above everything else will be a relic of the bygone days of the cable car—an interesting, antique curiosity.

CONTRACTS OPEN AND CLOSED

(*Continued from page* 710.)

Sunderland.—April 26th. The Corporation wants tenders for steam and other piping, and panels for traction switchboard. See "Official Notices" April 12th.

Swansea.—May 3rd. Tenders are invited for the electric wiring and fitting of the courts and offices at the Guildhall.

Swansea.—May 15th. The Corporation wants tenders for two-phase motor alternators and switch gear. See "Official Notices" to-day.

Tonbridge.—May 30th. The U.D.C. wants tenders for Lancashire boilers, two 50-kw. steam dynamos, condensing plant, crane, switchboard, battery, mains, arc and incandescent lighting, house meters, &c. See "Official Notices" April 12th.

CLOSED.

Aberdeen.—Messrs. Alley & M'Lellan have secured the contract for the supply of surface condensers and air and circulating pumps, &c., for the Electricity Committee.

Ayr.—The contract for balancers and boosters for the above station has been placed with Messrs. Bruce Peebles & Co. at £625.

Buxton.—At a meeting of the U.D.C. on 20th inst., a resolution was passed entering into contracts with the Electric Construction Company for a 250 kw. dynamo coupled to a Belliss T.C.T. 4 engine, for £2,825; and with the Sunderland Forge and Engineering Company for two 43-kw. dynamos coupled to a Belliss E.C. 6 engine, £1,269.

Colwyn Bay.—The D.C. received several tenders in connection with the extension of the electric lighting plant, and a contract was given to Messrs. Bertram Thomas & Co., Manchester, for water-tube boiler, &c., £1,298; switchboard work £63, and a dynamo, £1,347.

Durban.—Messrs. W. A. Baker & Co., Limited, of Newport, have secured the contract for the whole of the iron and steel work for the new electric tramway for the Durban (Natal) Corporation.

Leith.—The E.L. Committee has accepted the offer of the India-Rubber and Gutta-Percha Company, to supply a new steam dynamo for £3,398.

Stirling.—The Lighting Committee recommended that at last week's Council meeting the tender of Messrs. Arnott and Company, Coatbridge, for the two new boilers, in connection with the electric lighting, be accepted, the work to be completed in 20 weeks. The tender amounted to £1,280. The recommendation was adopted.

The Lighting Committee has contracted with Messrs. Callender's Company to supply certain electric light cable at 1s. per yard.

Walthamstow.—The Council recently decided upon certain mains extensions, and has now contracted with Messrs. Suter & Co. for the supply of another engine and dynamo at £2,250.

FORTHCOMING EVENTS.

Friday, April 26th.—At 8 p.m. Society of Arts. Howard Lecture, by A. C. Eborall, on "Polyphase Electric Working" (Lecture I.). The general treatment of polyphase problems: two-phase and three-phase systems—The general requirements of polyphase plant—Polyphase generators: standard types and leading features of design—Efficiency and pressure regulation—Short circuit current and pre-determination of the pressure drop on non-inductive and inductive loads.

At 7.40 p.m. North-East Coast Institution of Engineers and Shipbuilders. General meeting in the Lecture Hall of the Sunderland Literary Society. Mr. G. M. Brown will reply to the discussion on his paper on "Some Attempts to Increase the Efficiency of Marine Boilers," and the discussion on Mr. E. Griffith's paper on "Water-Tube Boilers," will be resumed.

Saturday, April 27th.—Institution of Electrical Engineers. (Students' Section.) Visit to the works of Messrs. Easton, Anderson & Goolden.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section). Meeting in the Institution Rooms, Newcastle-upon-Tyne.

Monday, April 29th.—At 8 p.m. Society of Arts. Cantor Lectures II., "Alloys," by Sir William C. Roberts-Austen, F.R.S.

Tuesday, April 30th.—At 8 p.m. Institution of Civil Engineers. Annual general meeting.

Wednesday, May 1st.—At 5 p.m. Royal Society. Annual meeting.

At 7.30 p.m. Institution of Electrical Engineers (Students' Section). Meeting. Paper to be read, "The Application of Electric Power to Machine Tools," by C. B. Nixon.

Thursday, May 2nd.—Röntgen Society. Meeting; paper by J. Cadett on "Some X Ray Improvements."

At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at Hotel Victoria, Northumberland Avenue, S.W.; paper on "The Storage of Electricity," by A. H. Allen.

At 8 p.m. Institution of Electrical Engineers. Ordinary general meeting at Institution of Civil Engineers. Papers on "An Instrument for Measuring the Permeability of Iron and Steel," by C. G. Lamb and Miles-Walker, and "A Watt-Hour Meter," by Frank Holden.

Friday, May 3rd.—Society of Arts. Howard Lecture, by A. C. Eborall, on "Polyphase Electric Working." Lecture II.—The parallel running of polyphase generators—The testing of large generators—Polyphase transformers; standard constructions and arrangements—Efficiency and drop; pre-determination of the latter on non-inductive and inductive loads—The heating of large transformers—Synchronous polyphase motors.

At 8 p.m. Institution of Junior Engineers. Meeting at Westminster Palace Hotel. The Northcott Prize Paper, on "How may the best efforts of Employers and Employed be exerted for their Mutual Advantage, and for the National Benefit?" by Mr. William Powrie.

Saturday, May 4th.—Institution of Electrical Engineers (Students' Section). Visit to the Davies Street works of the Westminster Electric Supply Corporation.

NOTES.

The National Electrical Contractors' Association.—Some weeks ago we referred in these columns to the movement which had been inaugurated with a view to forming a National Electrical Contractors' Association. Of necessity the progress of the Provisional Committee is slow, as one of the duties laid upon it was to foster the formation of local associations in London and the provinces, with a view to their future affiliation with the proposed National Association. With regard to London, we understand that steps are being taken to form four local associations, one each for the eastern, western, northern, and southern districts. We are asked to invite all London electrical contractors, who are in sympathy with the movement, to at once communicate with Mr. Thos. Guthrie, convener of Provisional Committee, at 46, Queen Victoria Street, E.C., on the subject, with a view to convening meetings in the several districts as early as possible for the purpose of forming the local associations.

Glasgow Exhibition.—The press view of the Glasgow International Exhibition was held yesterday (Thursday). The public opening ceremony will be performed on Thursday next by the Duke and Duchess of Fife.

The impression left upon us after a preliminary round of the Machinery Hall is that although many stalls are still incomplete, the exhibits, as a whole, are in a more forward state than is usual. The opening day should find them practically finished. The collection of machine tools, engines, dynamos, &c., is most interesting. American tools are largely represented, but British manufacturers are well to the fore, and the Exhibition as a whole is well worthy of a visit. It is the largest and most comprehensive ever held in the United Kingdom. The Art Section, housed in a magnificent building, is the gem of the Exhibition.

Mining Safety Lamps and Motive Power.—Messrs. S. F. Walker and H. Ravenshaw, at the last meeting of the Institution of Electrical Engineers on the 18th inst., replied to the discussion on their respective papers. Mr. Walker mentioned that the Sussmann gas-detecting apparatus was based on the occlusion of hydrogen by spongy platinum, but another means adopted was the diffusion of gases. There were three well-known means of securing lamps against interference (1) a set screw, (2) a lead rivet, and (3) the magnetic lock; but all of these could be tampered with, and if an ordinary lamp was opened, the consequences might be disastrous. The electric lamp put a miner in the position of a man who had no matches in his pocket and therefore could not strike a light. As carbonic oxide was always present after an explosion, caused by the ignition of the coal dust lying about a mine, it appeared that a detecting apparatus showing the presence of this gas would be of immense use. If a miner would carry a battery strapped round his waist, the problem was solved and an efficient lamp could be made at once. Mr. Ravenshaw explained that old winding engines could be used for dynamo driving, not those actually used for winding. Cables were knocked about but not cut through by things falling down a shaft. In timbered shafts the cables could be put at the back of the cross timbers, but in other shafts they should be placed at the sides. To hang them, the drum was taken to the bottom of the shaft, the cable was fastened on the cage which was then wound up. The cables were fastened every 100 yards by cleats with tension gear. No joints were permitted in the shaft. A non-inductive resistance placed in parallel with a magnet coil only wasted a very small percentage of the power, and it enabled the shunt to be broken without a flash. Extreme economy does not have to be considered in a pit, the great thing is to get the work done. Mr. Ravenshaw emphasised the field that was open for motor builders in dealing with surface work of collieries if this were only pushed. For example, colliery engines were so inefficient that where 70 tons of coal a week was burnt, the work could be done by modernising the plant on 20 tons. Referring to polyphase motors, he said that makers should strive to produce a motor with no slip rings but with good starting torque.

Proposed Visit of Workmen Abroad.—It is all very well to grumble because the British workman does not appear to grasp the reality of foreign competition. Many of them have never been abroad. Those who would go cannot afford it. Those who can afford it, and there are many, won't go. Mr. Tom Westgarth in *Cassier's Magazine*, proposes to get up a deputation of working men to visit the Continent and America, so as to see for themselves what is being done by rivals. The idea is certainly a capital one, if it can be carried out. We think much good might accrue from the scheme proposed, if it could be well managed. Those who go ought to be open-minded and willing to see the best. Unfortunately, most travellers are too occupied with seeing the worst. We hope that if the scheme is adopted, many of the employers will go with the men, for now that the employers have regained command in their own shops, they are remarkably backward in instituting the reforms they once professed to admire. It is said that a number of firms have already expressed their willingness to help. To be of any value, the number of delegates should be considerable, and drawn from all over the country, and there should be provision made for collecting and publishing information as to output, and our own firms ought to put their own plant and its output into comparison, so that all may read. There should be published a whole works wages list from several places—names might be omitted, but sufficient description of the locality given. We fancy that what will be most striking will be the small wages here in the small country towns—not that the men are not perhaps fully as well off—and the large wages of special branches. That wages are far above the standard of living is amply proved by the 30 or 40 hours per week which men work in some occupations to earn a living.

Chamberlain & Hookham, Limited, v. the Bradford Corporation.—In the Court of Appeal on Wednesday, before Lords Justices Collins and Stirling, the case of Chamberlain & Hookham, Limited, *v.* the Bradford Corporation was mentioned by Mr. Moulton, K.C., who applied for leave to introduce certain fresh evidence in an appeal which had been set down in the action. Learned counsel stated that in the Court below a point had been made as to the magnetic strength of two magnets.

Mr. Bousfield, K.C., who appeared on the other side, said that if his learned friend was only going to ask that the motion should stand over until the hearing of the appeal, it might save the Court a deal of trouble if he stated his intention not to oppose it.

Mr. Moulton said there was only this point. They were unable at the time to increase the strength of the magnets, but since the trial, measurements had been made of exactly similar magnets and in their opinion there had been a mistake of 20 or 30 times. Now all he asked was that before the appeal came on, and without prejudice to any question, one witness on either side might be examined with reference to the strength of these magnets. He might name Mr. Swinburne as a very suitable person, and he supposed his learned friend would desire either Prof. Ewing or Prof. Adams.

Mr. Bousfield said he saw no objection, and their Lordships, by consent, therefore directed the motion to stand over until the hearing of the appeal.

The Metropolitan E.S. Company v. Gender.—The report of this case, of which we publish an instalment in this issue, will, we think, be well worth reading by reason of the fact that the main point raised is one which, to our knowledge, has not arisen before in connection with electric supply matters. We shall conclude our report in next week's issue. The decision of Mr. Justice Buckley was that the supply company ought to have the injunction asked for.

The Opening of the Glasgow Tramways System.—The formal opening ceremony took place on Wednesday. A large number of members of the Corporation and visitors assembled at City Chambers at 11.30 a.m., and drove to the Pinkston generating station. After arriving at the station and inspecting the generating plant, &c., the first of the large Allis engines was started by Lord Provost Chisholm, who was then presented with a large silver flower bowl by Mr. Rosenthal, on behalf of the Babcock & Wilcox Company. The second Allis engine was then started by Mr. Walter Paton, convener of the Tramways Committee, who was presented with a similar memento by Mr. Duncan Stewart, on behalf of Messrs. D. Stewart & Co., Limited. Lastly, Mr. Phillips, of Mirrlees, Watson & Yaryan, Limited, presented Mr. John Young with a silver bowl. The company then returned to the city, where nine trolley cars were in waiting, and were taken to the Exhibition and back over part of the newly equipped tramways. Afterwards the visitors were entertained at luncheon by the Corporation. After the loyal toasts, Sir James Bell, proposing the Tramways Committee, and the success of the new undertaking, remarked that the scheme was taken in hand in 1894, and claimed for Glasgow the honour of being the pioneer of municipal electrical tramway enterprise. Already the receipts had exceeded £10,000 in one week. Bailie Paton, in reply, stated that owing to the successful management of the undertaking, prior to the conversion to electric traction, the capital outlay had been entirely repaid and the electrical scheme was started with a clean sheet. At present 14 route-miles of double track had been equipped, and eventually this will be increased to 75 route-miles. The Pinkston station had already cost £500,000, and the total capital outlay would ultimately be £2,000,000. All the lines leading to the Exhibition will be in full operation on the opening day. The Bailie concluded with a tribute of praise to the administrative ability of Mr. John Young and his staff, and to the engineering skill and energy of the consulting engineer, Mr. H. F. Parshall. The Provost of Govan proposed the toast of "The Tramway Officials and Engineers" in a eulogistic speech, and in reply, Mr. Young dwelt on the difficulty of pushing on the work when all the engineering works were busy; everthing was ready but the power station. Mr. Parshall, in replying, said that the Corporation of Glasgow would shortly be in possession of the finest power station in the world; there was nothing to equal it in the United States. He had adopted the polyphase system, of which the advantages had been demonstrated elsewhere, with a view to providing an up-to-date installation on a universal system which could be applied to lighting, traction, or any other purpose equally well. Mr. Parshall concluded with a warm testimony to the excellence of the organisation of the tramways department. Mr. McCartney then presented Mr. Wm. Clark, chief tramways engineer, with a silver flower bowl on behalf of the contractors, in token of their high esteem. Councillor Graham proposed the toast of the contractors, in reply to which Mr. R. W. Blackwell congratulated the Corporation on their magnificent power house "unequalled on earth," and expressed the contractors' hearty appreciation of the cordial assistance they had received from the Corporation and officials.

Obituary.—We regret to learn from our contemporary, *Industries* (Durban), of the death of Mr. J. W. Logan, M.I.M.E., which occurred at Cape Town on March 17th. Mr. Logan was the South African representative of Messrs. Davey, Paxman & Co., Limited, of Colchester.

We learn with deep regret of the death of one of the most distinguished of American scientists—Prof. Henry Augustus Rowland, Professor of Physics at Johns Hopkins University, Baltimore. A fairly detailed notice of his career appeared in the *Times* for Monday last, from which we abstract a few points:—"Prof. Rowland exhibited a strong bent towards scientific pursuits from an early age, and during his school-days spent most of his time in making chemical and electrical experiments, when in the opinion of his instructors he ought to have been devoting himself to Latin and Greek. At Troy he graduated as a civil engineer in 1870, and for a short time he acted as a railway engineer, but the occupation was not congenial, and he abandoned it to become instructor in natural science at Wooster University, Ohio, whence he soon moved back to Troy as assistant professor of physics. Here he carried out some of the earliest exact measurements of the magnetisation produced in iron and nickel by magnetising forces, elaborating for this purpose an original system of absolute units. But he failed to secure recognition of this work in America at that time, and even to obtain publication of the papers in which it was described; indeed, it was on this side of the Atlantic that its value was first perceived. When Clerk Maxwell's "Electricity and Magnetism" was published, Rowland found in that book many points in common with his work, and accordingly sent an account of his own researches to that great physicist for his consideration. The result was that they were immediately appreciated. In 1876 at Baltimore he engaged in one of his most important researches—a new determination of the mechanical equivalent of heat on a larger scale and with more elaborate refinements than had been employed by Joule. But he was probably best known for his work on diffraction gratings and spectroscopy. Prof. Rowland received numerous honours, both in his own and in other countries. So far as England is concerned, he was an honorary member of the Physical Society, the Manchester Literary and Philosophical Society, and the Cambridge Philosophical Society, and was elected a foreign member of the Royal Society in 1889. He was born in 1848."

On Monday, 22nd inst., took place the funeral of Mr. Thomas Barlow, who for nearly 30 years has filled the post of Sub-Controller, and recently of Deputy-Controller, of the Central Telegraph Office. Mr. Barlow was seized with a paralytic stroke on Thursday, 18th inst., whilst at Her Majesty's Theatre, and was removed to Charing Cross Hospital, where he expired during the afternoon of the following day. The deceased was much respected, and the suddenness of his death caused great pain and sorrow. His age was 61 years. The interment was attended by a numerous company of telegraph friends. Among the mourners in close attendance on Mrs. Barlow and her son was Mr. E. May, the Controller of the Central Telegraph Office, and among those present at the church and graveside we noticed Sir Henry C. Fisher, late Controller, C.T.O., Mr. Hookey, engineer-in-chief, Mr. J. T. Hill, late Assistant-Controller, C.T.O., Mr. Joseph Eames, Assistant-Controller, C.T.O., and Messrs. Warmington, Coates, Hilton, Aldous, Kennett, and a very considerable gathering of superintendents and assistant-superintendents. The Postal Telegraph Clerks' Association, representing the staff of the C.T.O., sent a magnificent wreath, and Messrs. C. H. Garland and G. W. Flood were present as delegates from that body. The service took place at Christ Church, Crouch End, and the interment in a beautiful spot in Highgate Cemetery. The early hour (11 a.m.) prevented many sympathisers from attending, but a goodly number collected at the graveside, and a large collection of splendid wreaths testified to the universal respect in which the deceased gentleman was held.

Personal.—The Calico Printers' Association, Limited, have recently engaged Mr. Wm. Cotsworth to carry out extensions to their electrical plant, and to further the application of electricity in their industry. Mr. Cotsworth is resigning his position as manager for Messrs. Drake and Gorham, in order to take up his new appointment.

Messrs. Clayton & Co., electrical engineers, &c., at Huddersfield, ask us to state that Mr. Charles G. Hampson is no longer in their employ as representative.

Mr. W. Alan Fraser, borough electrical engineer of Lancaster, who not long ago returned from the war under circumstances with which our readers are already familiar, has been appointed borough electrical engineer at Nelson at a salary of £300 per annum, it being the Council's intention to lay down a new station for lighting and tramways. There were 62 applicants for the post. Mr. Fraser was formerly at Edinburgh.

Mr. J. Gresham Barber has joined the staff of Messrs. Drake & Gorham in their Manchester branch, and has consequently resigned his position as manager of the electric department for Messrs. T. B. and W. Cockayne, Limited, Sheffield. He will take up his new duties in about a month's time.

The South-Western Polytechnic.—The annual conversazione and prize distribution took place last Saturday evening, Sir William H. Preece, F.R.S., performing several interesting functions in connection therewith, and also declaring open certain new buildings, which has just been completed at a cost of £10,000, this sum including their equipment. Sir William, after distributing the various awards, addressed a few words of counsel to the large number of student minds which formed his audience. Mr. R. C. Antrobus (chairman of the Governing Body) was in the chair, and among those present were the following: The principal, Prof. Tomlinson, F.R.S., Sir Alexander and Lady Binnie, Prof. Schwartz (head of Electrical Engineering Department), and Prof. Pullen (head of Mechanical Engineering Department). In the list of matriculated students of the day college who have obtained positions in electrical engineering upon leaving the Polytechnic, we notice several who are in the employ of prominent electric lighting companies, electrical contractors, and municipal electrical departments, or are engaged in electric railway work. The programme of general arrangements on Saturday evening was in every way an excellent one, with a variety of scientific lecturettes, exhibitions, workshop and laboratory inspection, musical and other similar attractions.

Tunbridge Wells Telephones.—A statement appeared in the *Pall Mall Gazette* a few nights ago to the effect that a telephone user residing at Brenchley, who was paying the National Company a fee of £60 per annum, is to be charged by the Tunbridge Wells Town Council a modest fee of one-tenth to one-twelfth that sum. It is a pity that the whole truth was not stated, as such half-truths are distinctly mischievous and misleading. The facts are as follows:—The line provided by the company is nearly ten miles long, running direct from Brenchley into the National Company's Tunbridge Wells exchange. The quotation given by the Tunbridge Wells Corporation is subject to a local exchange being opened in the village, in which case the line can be provided at the ordinary tariff rate without any charge for additional mileage. If there were sufficient support in the village to enable the National Company to open a sub-exchange there, the company, of course, could also quote the ordinary rate.

Poulsen's Telegraphone.—A few days ago we had the pleasure of seeing and hearing this instrument at No. 2, Angel Court, Throgmorton Street, and satisfied ourselves that the praise which was showered upon it when it was first brought forward was wholly justified. The speaking is singularly clear, and the instrument is so sensitive that it readily records words uttered in a low tone. Descriptions of it appeared in our issues of April 27th, and October 12th, 1900; we shall shortly supplement these by photographs of the actual apparatus. It is without doubt one of the most ingenious and beautiful applications of electro-magnetism ever devised.

Water-Tube Boilers.—In reply to Mr. W. Allan in the House of Commons on Monday, Mr. Arnold-Forster said that eight water-tube boilers of the Dürr type had been ordered from Germany. The total cost of the boilers is £19,450, and they are to be placed on board H.M.S. *Medusa*. They have been guaranteed by the makers to give 155,000 lbs. dry steam per hour from feed water at 80° F., and with an air pressure of 1½ in.; 104,000 lbs. per hour with ½ in. air pressure (that used for continuous steaming); and 80,000 lbs. per hour with natural draught.

Appointments Vacant.—The committee of the National Physical Laboratory will shortly appoint a superintendent of the engineering department at £400 per annum; one or two assistants in the physics department at £200 to £250 per annum; one assistant in the physics department at £200; also a number of junior assistants at £100 to £150. An assistant engineer is wanted for Eastbourne electricity works. See our "Official Notices" to-day for details.

For Sale.—The Birmingham City Council is offering for sale three Willans-Crompton steam sets with compound-wound dynamos. See our "Official Notices" to-day.

McDonnell v. Heyl-Dia.—At the Manchester Assizes, Thomas McDonnell, foreman cable maker, brought an action against G. E. Heyl-Dia, managing director of the St. Helens Cable Company, Limited, for damages for detention of a share certificate. Plaintiff's case was that in return for services rendered, he had been presented with 10 fully paid-up shares in the company, but after he signed the certificate, it was taken by the defendant, who now alleged that the shares were only to be given to the plaintiff conditionally on his giving satisfaction to the defendant. Mr. Justice Darling ordered a return of the certificate to the plaintiff, failing which he awarded him £200 damages.

Wigan Electricity Works.— The electric light and tramway works at Wigan, which we describe in this issue, were opened on Wednesday. At the invitation of the chairman of the Electric and Tramways Committee (Mr. Councillor Worthington), the members of the Council and their wives assembled at the works to witness the ceremony and afterwards inspect the works. The Mayor (Mr. Councillor Fyans) performed the opening ceremony. Councillor Worthington presented his worship with a silver key, and in doing so explained that the ceremony would have been performed earlier in the year but for the lamented death of Queen Victoria. The Mayor referred to the advantage the works would be to the town, and then started the engines and declared the works open.

Manchester Tramways.—The Corporation have commenced running a tramcar by the overhead wire system in Queen's Road, Cheetham, but at present it is confined to the tuition of drivers and conductors in the employ of the Manchester Carriage and Tramways Company. Tuition is also being given at Longsight. The announcement has been received with gratification by the members of the Corporation Tramways Committee.

Institution of Mechanical Engineers.—Last Friday night Mr. W. H. Maw delivered his presidential address before the members of this Institution. He had a good deal to say about the education of young mechanical engineers.

Appointment. — Mr. Norman has been appointed borough electrical engineer for East London, South Africa. He was previously assistant to Mr. Roberts, borough electrical engineer, Durban.

NEW COMPANIES REGISTERED.

Electrical Supplies, Rubber and Ebonite Company, Limited (69,894).—This company was registered on April 20th, with a capital of £1,000 in £1 shares, to carry on the business of manufacturers of and dealers in electrical machinery, cables and all accessories required for electric lighting, traction and power, and of and in all things necessary or useful for carrying on such business or usually dealt in by persons engaged therein. The first subscribers (each with one share) are:—Albert E. Page, Temple Buildings, Albert Street, Nottingham, chartered accountant; Alfred C. W. Rogers, Temple Buildings, Albert Street, Nottingham, chartered accountant; Bernard Barnett, 4, Belvoir Road, West Bridgford, Nottinghamshire, clerk; Samuel H. Page, 12, Vickers Street, Nottingham, lace manufacturer's manager; William H. Page, Yorkshire Chambers, Sheffield, electrical engineer; Edgar Senior, 8, Ossington Villas, Sherwood Street, Nottingham, clerk; and Angus McGougan, 30, Shakespeare Villas, Nottingham, clerk. No initial public issue. The subscribers are to appoint the first directors; qualification, 25 shares. Registered office, Yorkshire Chambers, Angel Street, Sheffield.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Charing Cross and Strand Electricity Supply Corporation, Limited (29,122).—This company's annual return was filed on April 10th, when 50,000 ordinary and 50,000 preference shares were taken up out of a nominal capital of £800,000 in 80,000 preference and 80,000 ordinary shares of £5 each; £5 per share has been called up, resulting in the receipt of £500,000. No mortgages or charges.

Chelsea Electricity Supply Company, Limited (20,468).—This company's annual return was filed on April 4th, when 44,436 ordinary, 6,000 preference, and 500 founders' shares were taken up out of a nominal capital of £400,500 in 74,000 ordinary, and 6,000 preference shares of £5 each, and 500 founders' shares of £1 each; £5 per share has been called up on 28,143 ordinary, and 6,000 preference, and £2 per share on 9,627 ordinary shares, resulting in the receipt of £189,969; £33,830 considered as paid on 6,666 ordinary, and 500 founders' shares. Mortgages and charges—£150,000 debenture stock, and £88,000 buildings.

Westminster Electric Supply Corporation, Limited.—This company's annual return was filed on March 19th, when 109,520 shares were taken up out of a nominal capital of £550,000 in 110,000 shares of £5 each; £5 has been called up on each share, resulting in the receipt of £547,600. Mortgages and charges, £250,000.

SUPPLY STATION ACCOUNTS.

Bradford Corporation Electricity Accounts.

The increase in private supply load is the marked feature of last year's accounts of the Bradford Corporation. The total increase is over a million units; of this about two-thirds is derived from private consumers, the remainder being accounted for by the trams, which took nearly a million units themselves. The load factor is not quite so good, as the load has increased more rapidly in proportion to the output than in the previous year.

General Statement.

	1899.	1900	Increase.
Total capital expenditure ...	£210,055	£241,410*	£31,355
Number of units sold	2,416,130	3,424,658	1,008,528
Number of 30-watt lamps connected	132,631	172,741	40,110
Maximum load in KW.	2,010	2,742	732
Gross revenue	£30,455	£38,547	£8,092
Gross expenditure	£13,495	£20,502	£7,007
Gross profit	£16,960	£18,045	£1,085
Average price per unit sold ...	2·32d.	2·49d.	−·33d.

* *i.e.*, £245,146, less depreciation, £8,737.

The revenue account shows a slightly greater increase than in the previous year. The increases in power supply and traction load have caused the return per unit to drop ⅛d. The sales are spread over the different classes of consumers thus:—

Public lamps. 51 arcs of 600 watts consumed.	Private lighting. Charged at 4½d. per unit less 2½ %, and free lamps.	Motive power. Charged 2d. for intermittent, and 1d. for continuous use. Heating at 2d. per unit.	Tramways.
76,445 units.	1,461,262 units.	933,455 units.	953,496 units.
£524.	£30,980.		£3,973.

The motor and arc lamp department earned £1,471 from hire, and £389 from sales of apparatus, and cost, £1,523, leaving a profit of £337.

Revenue Statement.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Increase.
Sale of energy	£28,367	2·82d.	£35,477	2·49d.	−·33d.
Meter rents	839	·03d.	1,078	·07d.	−·01d.
Sale of lamps, &c., and hire of motors and arc lamps	1,247	·13d.	1,988	·14d.	+·01d.
Sundry rents	2	·00d.	4	·00d.	·00d.
Gross revenue ...	£30,455	3·03d.	£38,547	2·70d.	−·33d.

The public lighting has not been extended as in 1899. There were 51 arcs and 12 incandescents. The general figures for the past three years are:—

	Units generated.	Private supply.	Public lighting.	Tramways.
1898 ...	1,568,459	1,184,996	32,291	202,019
1899 ...	2,858,841	1,738,844	59,004	618,282
1900 ...	4,141,284	2,394,717	76,445	953,496

The plant installed totalled 3,600 KW., and the maximum loads were lighting 2,275 KW., and traction 467 KW.

The cost of coal has gone up from ·33d. in 1897 to ·42d. last year, but the increase was wiped out by a reduction of ·06d. in wages. As repairs have risen by over ½d., this adversely affected works costs. A drop of merely $\frac{1}{10}$d. in establishment charges brought down the alteration in total cost to an increase of $\frac{1}{10}$d., and it therefore stands at ½d. below 1897. Rent, rates, &c., have more than doubled, showing that the gross of this item in 1898 was unduly low. Mr. Chattock is ably continuing the excellent work of Mr. Gibbings.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Increase.
Coal	£3,579	·36d.	£5,976	·42d.	+·06d.
Oil, waste, water and engine room stores.	640	·06d.	881	·06d.	·00d.
Salaries and wages incurred in generation and distribution.	2,553	·25d.	2,724	·19d.	−·06d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps.	1,465	·15d.	4,240	·30d.	+·15d.
Works costs ...	£8,237	·82d.	£13,821	·97d.	+·15d.
Rent, rates and taxes ..	928	·09d.	1,903	·13d.	+·04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,164	·12d.	1,546	·11d.	−·01d.
General establishment charges, stationery and printing, law charges and insurance	1,659	·16d.	1,029	·07d.	−·09d.
Other expenses*	1,507	·15d.	2,203	·16d.	+·01d.
Total costs ...	£13,495	1·34d.	£20,502	1·44d.	+·10d.

* Incandescent lamps and maintenance, &c., of arc lamps and motors on hire.

Although the profit statement only shows £2,731 transferred to the depreciation account, the actual sum was £4,181, being made up to this by some of the net profits of 1899 and previous years. As financial charges have risen by £3,484 and gross profit only by £1,085, the net profit last year was £2,399 less than in 1899.

Profit Statement.

	1899.	1900.
Interest on loans and overdraft	£5,083	£5,830
Sinking fund for repayments	6,747	9,484
Net profit carried to depreciation fund	3,816	2,731
„ carried forward	1,314	—
Gross profit	£16,960	£18,015

Sunderland Corporation Electricity Accounts.

In 1897 the electricity supply undertaking of the Sunderland Corporation had to charge a deficit of £603 to the rates; the corner was turned in 1898, when a profit of £352 was made. In the latter year the units sold increased by over 200,000 in a total of 472,000, and this growth has been very nearly maintained, for the increase in 1899 was 168,000 units. The business done has necessitated a new central station, for which a site has been negotiated in Hylton Road, and here will be concentrated the future principal plant, room being provided for at least 15,000 H.P. At the end of 1898 the capacity of the old, or Dunning Street, works was 693 KW., to which in the next year were added three 200-H.P. sets, and further extensions of four 420-H.P. sets for lighting and traction have since been fixed. When these are completed, the Dunning Street works will occupy the whole of the available site, and contain 1,980 KW., or 3,600 H.P., for which the cost per KW. will be £56. Mr. J. F. C. Snell, the engineer for both lighting and tramway schemes, has converted the residential district from alternating to continuous supply, making one uniform system throughout the town, and has fixed a number of section pillars on the mains.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£61,931	£83,747	£21,816
Number of units sold	472,343	640,079	167,736
Number of lamps connected ...	25,617	35,024	9,407
Maximum KW. demanded ...	414	682	268
Gross revenue	£6,959	£9,804	£2,845
Gross expenditure...	£4,105	£5,757	£1,652
Gross profit	£2,854	£4,047	£1,193
Average price per unit sold ...	3·41d.	3·50d.	+·09d.

The receipts from sale of energy stand at 3½d. per unit, which is low for a station selling less than two-thirds of a million units, and is second, having regard to output, only to Oldham for the year in question. A small increase in the sales of lamps, &c., brings the receipts from all sources up to 3⅝d. per unit.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy..	£6,713	3·41d.	£9,338	3·50d.	+·09d.
Meter rents	187	·10d.	272	·10d.	·00d.
Supply of lamps, &c. ..	15	·01d.	162	·06d.	+·05d.
Sundry rents & deposit fees	44	·02d.	32	·01d.	−·01d.
Gross revenue ...	£6,959	3·54d.	£9,804	3·67d.	+·13d.

The rise in the price of coal was equivalent to an increase of over 50 per cent. in that item alone, and meant ½d. rise per unit. Taking wages and repairs together, owing to the attendance on, and repairs of, street lamps not being separated in the accounts, all the other items have fallen, and the influence of coal is only to increase works costs by ⅛d., and total cost by less than $\frac{1}{10}$d. per unit. Eliminating street lighting, Mr. Snell gives the works costs at 1·32d. in 1898 and 1·48d. in 1899, for the same years the total cost was similarly 1·99d. and 2·10d.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£1,047	·53d.	£2,027	·76d.	+·23d.
Oil, waste, water and engine room stores	231	·12d.	281	·10d.	−·02d.
Salaries and wages incurred in generation and distribution	1,040	·53d.	1,072	·40d.	−·13d.
Repairs and maintenance of buildings, boilers, engines, dynamos, &c.: attending and repairs to street lamps	464	·23d.	715	·27d.	+·04d.
Works cost ...	£2,782	1·41d.	£4,095	1·53d.	+·12d.
Rent, rates and taxes ..	311	·16d.	320	·12d.	−·04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	719	·36d.	954	·36d.	·00d.
General establishment charges, stationery and printing, law charges and insurance	293	·15d.	388	·15d.	·00d.
Other expenses	—	—	—	—	—
Total costs ...	£4,105	2·08d.	£5,757	2·16d.	+·08d.

Had it not been for the increase in coal, a clear profit of over £1,100 would have been made. As it was, the financial charges increased by £1,078 and the gross profit by £1,193, leaving £115, which, added to the previous net profit, left this at £467 for 1899, a result quite satisfactory considering the size of the works and the moderate output.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£1,166	£1,756
Sinking fund for repayments	1,336	1,824
Net profit carried to rates	352	467
Gross profit	£2,854	£4,047

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Company.

THE fifty-fifth half-yearly ordinary general meeting of the above company was held at Winchester House, E.C., on Wednesday afternoon, the Marquis of Tweeddale presiding.

In moving the adoption of the report, the CHAIRMAN said the gross revenue for the half-year was £360,889, being an increase of £21,439, and inasmuch as they had received in the half year £11,000 less from Government subsidies, the accounts were even better than they appeared. The increased revenue was mainly derived from China and Japan. The working and other expenses amounted to £104,640, a decrease of £12,295. This was accounted for by the expense of maintaining the cables having been considerably less than in the corresponding six months. Comparing the figures of the whole year, the results were that the gross revenue was £674,116, an increase of £10,305, while the expenses amounted to £213,300, being a decrease of £10,901. With the bonus and dividend, there would be a return of 7 per cent. to the shareholders for the year. The revenue balance of £141,481, with the premium of £150,000 on the issue of new shares had been carried to general reserve, which now amounted to £1,248,395, after having been debited with £125,137 for expenditure to date on the Cape-Australian cable. In conjunction with the Great Northern Company, further important works had been carried out in North China by constructing landlines between Taku, Tientsin and Peking in connection with the international cables laid, and opened by them last autumn, and the companies had also arranged to strengthen telegraphic communication between Shanghai and Taku by laying a duplicate cable between Chefoo and Taku. The Netherlands-Indian Government had decided to establish cable communication between Java and Borneo, and had entrusted that company to construct and lay the same. The manufacture of the cable was now completed, and they expected to have it laid before the end of the current half-year. The Government, they understood, also intended to construct a landline between Bandjermasin, where the Borneo end of the cable would be landed, and Kœtei, the centre of a large oil industry in Borneo, and when this was completed, it ought to form an important feeder to the company's system. The standard revenue fixed by the Cape-Australian agreement for regulating the Australasian tariffs was maintained during the past year, and was reduced as arranged for on January 1st to 3s. 6d. per word for telegrams exchanged with South Australia, West Australia, and Tasmania. Since the close of the year the Government of New South Wales had accepted the agreement. Any further action, however, with regard to the States would have to be made by the Federal Government. A portion of the Adelaide—Perth section of the Cape—Australian cable, and the Durban—Mauritius section of the cable had gone out. The manufacture of the remaining sections was being rapidly proceeded with, and it was expected that the cable would be open for traffic before the end of the present year. A contract had been entered into by the Governments interested for the laying of the all-British cable at an initial expenditure of roundly £2,000,000. When the cable was open they did not think it likely that a single line of cables with one unbroken stretch of 3,600 nautical miles could effectually compete with the vast network of triplicate and quadruplicate cables of the company. The company had already given evidence before the Inter-Department Committee appointed to inquire into the present system of telegraphic communication between different parts of the Empire. In view of the persistent attacks made upon the associated telegraph companies by ill-informed agitators, the directors cordially welcomed the opportunity afforded by the inquiry of explaining matters which had been frequently put before the public in an inaccurate and misleading light. In conclusion, the chairman referred to the Marconi system of wireless telegraphy, and said that the sensational reports as to communication across the Pacific were groundless. The system was most useful for communicating with lighthouses and with passing ships, and so on, and should form a valuable feeder to the company's cables.

Mr. F. A. BEVAN seconded the motion, and the report was adopted.

London Electric Supply Corporation.

LORD WANTAGE presided on Tuesday last over the ordinary general meeting of the shareholders of this corporation held at the Westminster Palace Hotel, S.W., and in moving the adoption of the report (see next page), said that he trusted that they would consider his remarks reassuring. He stated at the last annual meeting that, owing to the default of the contractors not delivering additional plant required for the winter of 1899, the existing plant had been subjected to such a severe strain that it had caused it, firstly, to become inefficient, and finally to break down altogether, and that it was only by the most unremitting care of the efficient staff that they were able to get through the winter at all. After very careful consideration, they determined that the installation should be shut down, and it was shut down in April last year, and they did not commence running again until October. During that period they received the whole of their current from three companies whose mains adjoined their own. They were grateful to their friends for that assistance, as it enabled them to retain their customers, but the price charged for the energy so purchased left them no margin of profit. The profit they saw in the revenue account was made as a result of their own working, and principally during the last quarter of the year. It was very disappointing that they had to pass over the preference dividend that year, but on the other hand, the shutting down of the station had been so beneficial to their future interests, that he thought the policy adopted was a wise one, and justified the advice given them, and justified them in expressing the hope that the passing over of the preference dividend was only temporarily. Last year he gave them an account of the additions and improvements they proposed to make, and now he had to inform them what had been done. The two engines of 450 H.P. each, which they ordered from Messrs. Allen & Son, were completed in the autumn, and had been running satisfactorily and efficiently since that time. The Thames Engineering Company, Limited, had reconstructed three large Plenty engines, and those were now all working with greater efficiency and larger output than before. They had themselves reconstructed their two Hick-Hargreaves large engines, and also increased their efficiency and power. The new battery of Davey-Paxman boilers, six in number, each of 400 H.P., of the Economic type, had been put down. Babcock & Wilcox had entirely reconstructed their boilers, and they had now a total of 12 boilers in all of 250 H.P. each, so that with the six Economic boilers purchased in 1899, they had boiler power of a total capacity of 8,000 H.P., all of which was nearly equal to new. A new system of steam pipes in duplicate had been laid down for the entire station, replacing the old system, which was inefficient and extravagant. By means of those they were able, if required, to shut down one side of the station and work from the other. They had completed a new chimney 240 ft. high, and by that means had avoided all their smoke troubles. They had also built a new transformer house outside the main building of the generating station, and transferred the whole of the transformers previously inside the main building, thereby considerably reducing risk of failure to the local service. They had put down a new exciting plant by Willans & Robinson, and had erected a new switchboard of a modern type for controlling the general excitation of existing plant. The entire electrical plant at the station had been completely overhauled, and the only new work not complete was a well from which they would obtain the whole of their water which had previously cost them £2,000 per annum. They recommenced running for a part of their supply in October, and for the whole of their supply in December, and up to the present time, they had had no trouble whatever with their machinery or plant. In addition to this the cost per unit, both generated and sold, had been diminished by half, as compared with the same quarter of 1900, and notwithstanding the increased cost of coal. Those results were most gratifying, and they had every reason to believe that they would be maintained during the remainder of the year. In London itself they had laid down 9,861 yards of new mains, and had increased the capacity of some of their distributing stations, as was to have been expected. During the period of their imported service in the winter, they lost a number of customers, but it was pleasant to be able to report that as a result of the satisfactory running of the past four months, they had made up the number of lights to within 1,000 of the largest number previously connected, and the orders they were at present receiving were most encouraging and justified them in saying that the previous record would soon be passed. It was necessary to find money to meet these expenses, and they had two courses open. One was to make a further issue of debentures, and the other to obtain a temporary loan from the bankers. Circumstances were not favourable for the issue of debentures, and so they adopted the latter course, and their bankers accommodated them with a temporary loan, on account of which they had received £45,000 to the end of the year, which amount would be increased when the new works were entirely paid for. The loan was made on the security of unissued debentures, and they hoped that soon the market would be favourable for an issue of debentures, and

that they would be able to take them up amongst themselves. They would notice that the directors had relinquished 75 per cent. of their fees. They had been successful in the Divisional Court in an action brought against them for the use of transformers, and an appeal against the judgment had been subsequently withdrawn. He saw no reason why they should not soon be in a much improved position, and he anticipated that, as a result of the year's working, they would resume the payment of a preference dividend; and as a holder of nearly two-fifths of the capital of the company, he might say that he had every confidence in the future of the company.

Sir W. H. Preece, in seconding the motion, stated that he had paid a visit to Deptford and made a thorough inspection of the works. He came away elated, for nothing could be more promising than the plant as it at present existed.

Various questions having been replied to by the Chairman, the report was adopted.

The directors' report for the year ending December 31st, 1900, reads as follows:—

"The profit on the working for the year is £8,825 16s. 6d,, to which has to be added interest on money on deposit £270 11s. 5d., and the amount brought forward from last year £1,460 6s. 7d., making a total of £10,556 14s. 6d. Out of this the interest on debentures and temporary loan to December 31st—viz., £10,507 5s. 10d.—has been paid, leaving a balance of £49 8s. 8d. to be carried forward. The directors regret that the preference dividend has been passed for the year. The reason for this is that, owing to the default of the contractors in delivering the additional plant for the winter of 1899—1900, referred to in last year's report, the strain thrown upon the existing plant was so great that it was found necessary to completely overhaul, and in some cases reconstruct it; and to enable this to be done efficiently the directors, acting upon the advice of their consulting engineer, shut down the generating station early in April last, having previously arranged to get a supply of current from three neighbouring supply companies. The station resumed working for partial supply in October, and for the entire supply early in December. The directors are glad to be able to report that since the station resumed working no hitch of any kind has occurred, the supply being of the most satisfactory nature. The directors, while grateful for the assistance rendered to them by other companies during the period the generating station was shut down, as it enabled them to retain their customers, desire to point out that the price charged for the energy so supplied left them no margin of profit, the profit shown on the revenue account having been the result of the workings during the times the station was running. The whole of the plant and machinery at the generating station is now in an efficient condition. The directors were of opinion that it would commend itself to the shareholders if the date of the annual meeting were postponed until the result of the workings for the March quarter could be obtained, to enable them to report the effect of the alterations and renewals which had been carried out during the time the station was shut down as regards the works costs. This has now been ascertained, and it shows a reduction in the cost of generation as compared with any previous quarter, and the profit on the quarter's workings is nearly equal to that shown for the whole of last year, although the price of coal is still high. The directors anticipate that these gratifying results will be maintained. As the result of the satisfactory supply a steady accession of new orders has been and is being received, and the directors are pleased to say that the number of lights connected up to the date of this report is within 1,000 of the previous maximum. The retiring directors are Sir W. H. Preece and Mr. R. Stewart Bain, who are eligible for re-election."

Buenos Ayres and Belgrano Electric Tramways Company.

The annual meeting of this company was held on the 19th inst. at River Plate House, E.C.

Mr. J. B. Concanon, who presided, stated that the receipts for 1900 exhibited an increase, as compared with those for 1899, of £11,026, while the expenses showed a decrease of £2,187. The increase in the earnings and the diminution in the expenditure were due to the gradual change from horse to electric traction over the company's lines last year. The result of the working for the period under review was an available profit, including the balance of £1,776 brought forward, of £39,736. The details of the working expenditure for the whole of 1900 were not given in the accounts owing to the fact that the mixture of horse and electric traction would have been misleading. Electric traction was inaugurated over the whole of the lines on September 10th, and the net results for the three months ended December 31st last showed receipts aggregating £38,320, and expenses equal to about 55 per cent. of that amount. This would give some idea of what the results of electric traction might be. It was only right to point out, however, that the concluding portion of the year was generally the best, October, November, and December being a portion of the summer at Buenos Ayres.

Brighton and Rottingdean Seashore Electric Tramway Company.

On Tuesday, April 16th, Mr. J. J. Clark presided at the meeting of this company. The directors regretted the result of the year's working owing mainly to it having become necessary to relay the rails round the new groyne of the Corporation, which had necessitated the closing of the line, during the profitable part of last year. The loss thus involved amounted to fully £500. In consequence of this suspension of traffic and the large amount expended in repairs, the result of last year's working showed a loss of £287 7s. 5d.

The Chairman in proposing the adoption of the report, complained of the action of the Corporation in having constructed a groyne across the company's rails, and maintained that although the Act of Parliament gave the Corporation the right to give the company notice to remove their rails if the Council desired to lenghten their groynes, that power should have been exercised reasonably, and it was unreasonable to expect the company to do something that was impossible. It seemed to him that the Corporation had no right to stop their line and to take up their rails without removing them to a point to which the Corporation desired them to be placed.

The report was adopted.

Oriental Telephone and Electric Company.

The directors' report for the year ended December 31st, 1900, to be presented at the meeting to be held at Cannon Street Hotel, E.C., to-day, April 26th, at 2 o'clock, reads as follows:—

The directors herewith submit to the shareholders a report and statement of the accounts of the company for the past year. The revenue account shows a balance to credit of £13,456 4s. 5d. transferred to profit and loss, including £1,507 16s. 10d. brought forward from 1899, and after deduction of £4,287 12s. paid as interim dividend on November 1st, there remains £10,676 9s. 3d. for disposal. The directors recommend dealing with this sum as follows:—To pay a final dividend of 3½ per cent., free of income tax, making, with the interim dividend of 2½ per cent. already paid, 6 per cent. for the year; to transfer to reserve £2,000, and to carry forward £2,673 16s. 6d. The electric lighting branch of the company's business shows an increased surplus over that obtained in 1899, and the current year has opened with a fair amount of business on hand. The dividends declared by the Indian subsidiary companies have, as usual, been included in the revenue account, and the amounts have been duly remitted to us. Both these companies have again paid 6 per cent. for the year, and have carried forward substantial sums for future contingencies. The Telephone Company of Egypt, Limited, has declared a dividend of 7½ per cent. on its preferred shares, against 6 per cent. in former years, and has also transferred a considerable sum to reserve for further developing the business. The China and Japan Telephone Company has paid its debenture interest and makes fair progress, but the accounts for the past year have not yet been presented to the shareholders. A small exchange has been opened at Johore during the year, which is in direct communication with the company's system in Singapore. The company has also been granted a license by the Government of India to open an exchange at Mandalay. Under Article 65, the directors to retire at the present meeting are Sir Auckland Colvin and Mr. H. Johnstone Grewing, who being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election.

North Staffordshire Tramways Company.

The annual report to December 31st, 1900, presented to the meeting held yesterday at Donington House, W.C., reads as follows:—

During the past year no further capital has been issued. The total amount of debentures issued is £93,400 of first debentures out of an authorised total of £100,000, and £30,100 of second debentures out of an authorised issue of £40,000. The expenditure during the year on the electrical equipment, permanent way, depôt, &c., has amounted to £14,348 13s. 8d., and there is owing to the Potteries Electric Traction Company £17,812 9s. 1d. The profit for the year, from the rental of the lines, after payment of debenture interest, is £4,858 3s., which, added to £12 11s. 3d. brought forward from last account, makes an available balance of £4,870 14s. 3d. The directors recommend that this balance should be applied as follows:—To pay a dividend of 6 per cent. per annum on the preference shares, amounting to £1,200; to pay a dividend on the ordinary shares of 5 per cent. per annum, amounting to £3,600; and to carry forward £70 14s. 2d. Arrangements are in progress for the repayment of the present 5 per cent. first mortgage debentures at the rate of £105, and for the issue of debentures bearing interest at the rate of 4½ per cent., under a trust deed which will relieve the company from the onerous terms of the present trust deed. The lines are being worked by the Potteries Electric Traction Company under the terms of the agreement, which was sanctioned by the shareholders at the general meeting last year. At the conclusion of the ordinary general meeting an extraordinary general meeting will be held for the purpose of considering an alteration in the articles of association as to the qualification and election of directors. Mr. Wm. Pering Paige is the director who retires by rotation, and is eligible for re-election. Mr. William Stansfield, the auditor, also retires and offers himself for re-election.

Prospectuses.

The list of applications opened on Monday and closed on Wednesday for subscriptions to an issue of £250,000 4½ per cent. first mortgage debenture stock in the British Insulated Wire Company. The prospectus stated:—

At the present time it has on its books orders exceeding £400,000 in value from the home and Colonial Governments, municipal authorities, and electric supply companies, and the works are taxed to their utmost capacity.

Owing to the impossibility of further increasing the output from the present works the company has been obliged to refuse large and profitable orders, and as the demand is likely to be even greater in the future, it is essential that additional buildings and plant and more working capital should be provided. An amount of £93,200 of debentures [now the only charge on the assets] will be repaid out of the proceeds of this issue, and the balance, after payment of expenses of issue, will provide about £215,000 for development of the business.

The Merthyr Electric Traction and Lighting Company, Limited, is inviting applications until Saturday for an issue of 6,000 5 per cent. cumulative preference shares of £5 each, has a capital of £100,000 equally divided into preference and ordinary shares. The company has agreed to pay the British Electric Traction Company £66,000 for the transfer of the Light Railway Order (subject to the consent of the Board of Trade); so much of the railway as had been constructed on January 31st last, and for the transfer of £1,179 2¾ consolidated stock. An issue of £30,000 debentures is contemplated to provide the balance of the purchase price. The present issue has been guaranteed by the British Electric Traction Company.

Calcutta Tramways Company.

The report for the year 1900 shows gross receipts £80,946, expenditure £65,720, and a revenue balance of £15,226 which, added to the balance brought forward, gives a total of £40,868. For the first half of the year the work of reconstruction continued to affect the receipts prejudicially, but during the second half, when reconstruction was complete on most of the lines, the traffics began to show a very satisfactory expansion, which is well maintained. The necessary works for the electrical equipment of the system are proceeding rapidly. The company has acquired several plots of freehold land for the power station buildings and car sheds, and the construction of these buildings, which is outside the contract, is well forward. The contractors' work is also being pushed forward, and much of the plant is already on the spot, and being dealt with by the contractors' representatives. The directors will shortly issue the remaining £100,000 4½ per cent. debentures created to provide for the payments to the contractors necessary to complete the equipment.

Oswestry Electric Lighting and Power Company.

The following is the report of the directors to be presented to the annual general meeting of shareholders:—

The accounts of the company for the year 1900, show continued progress, although the high price of coal has seriously reduced the available profit. The gross profit for the year amounts to £251 8s. 11d. which with £20 9s. 2d. brought forward from 1899, makes an available balance of £271 18s. 1d. The directors have written a further sum of £18 0s. 6d. off the preliminary expenses, and have charged to revenue the balance of the cost of the renewal of the batteries referred to in their last report. They recommend the declaration of a dividend at the rate of 4 per cent., leaving £1 4s. 5d. to be carried to next account.

Stock Exchange Notices.—The Committee has been asked to appoint a special settling day in:—General Electric Company (1900), Limited—18,000 5 per cent. cumulative preference shares of £10 each, fully paid, Nos. 7,001 to 25,000, and £150,000 4 per cent. first mortgage debenture stock. The Committee has further been asked to allow the following securities to be quoted in the official list:—Edison and Swan United Electric Light Company, Limited—£100,000 5 per cent. second debenture stock, in lieu of the provisional certificates now quoted. Notting Hill Electric Lighting Company, Limited.—Further issue of 2,200 ordinary shares of £10 each, fully paid, Nos. 10,001 to 12,200. The Committee has appointed a special settling day as under:—Thursday, April 25th. Cape Electric Tramways, Limited.—Further issue of 40,000 shares of £1 each, fully paid, Nos. 400,001 to 440,000, and has also ordered the under-mentioned to be quoted in the official list:—Willans & Robinson, Limited.—Further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 80,000 to 90,000.

St. James's and Pall Mall Electric Light Company.—The amount of electricity sold by the company, for the quarter ended Lady Day, 1901, is returned at 1,778,340 units, estimated to produce £31,121, as against 1,599,768 units, which produced £28,062, for the corresponding period of last year.

Cuba Submarine Telegraph Company.—Dividend on ordinary shares for half-year to December 31st, 4 per cent. per annum.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending April 19th were £428; corresponding week last year, £615; decrease, £186. Total to date, £6,738; corresponding period last year, £6,117; decrease, £621. Miles open, 8½. Partly electrical and steam.

Blackpool and Fleetwood Tramways.—The receipts for the week ending April 20th were £269; corresponding week last year £758; decrease, £489. Total to date, £3,242; corresponding period last year, £3,525; decrease, £283.

Bristol Tramways and Carriage Company.—The receipts for the week ending April 19th were £4,055 17s. 7d.; corresponding period last year (Easter week), £3,899 14s. 4d.; increase, £156 3s. 3d.

Central London Railway.—The receipts for the week ending April 20th, were £6,443; previous week, £6,652; decrease, £209. Total receipts to date (16 weeks), £97,984. Miles open, 6.

City and South London Railway.—The receipts for the week ending April 21st were £1,929; corresponding week last year, £1,211; increase, (Moorgate extension open) £718. Total to date, £32,020; corresponding period last year, £19,689; increase, £12,331. Miles open, 1901, 4¾; 1900, 3¾.

Dover Corporation Tramways.—The receipts for the week ending April 20th were £195 18s. 5½d.; corresponding week last year, £247 7s. 11½d.; decrease, £51 9s. 6d. Total to date, £2,668 0s. 7½d.; corresponding period last year, £2,487 0s. 11½d.; increase, £180 19s. 8d. Miles of track open, 8; Car miles run, 1901, 5,999; 1900, 4,953. Number of cars, 1901, 11; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending April 19th were as follows:—D. U. T. Co., electric cars, £3,444 10s. 10d.; D. S. D. Co., electric cars, £757 12s. 9d.; total £4,202 3s. 7d.; corresponding week last year—D. U. T. Co., electric cars, £4,389 9s. 11d.; ditto, horse cars, £72 10s. 4d.; D. S. D. Co., electric cars, £1,505 12s. 11d.; total, £5,917 13s. 2d.; decrease, £1,715 9s. 7d.; aggregate to date, £60,576 5s. 1d.; aggregate to date last year, £61,452 10s. 5d.; decrease, £876 5s. 4d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses for the corresponding period last year. (Easter week, Spring Show, and Queen Victor a's visit, 1900.)

Liverpool Overhead Railway.—The receipts for the week ending April 21st were £1,644; corresponding week last year (includes Bank Holiday), £1,665; decrease, £21. Total to date, £24,328; corresponding period last year, £22,470; increase, £1,858. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The issue to the general public of 30 millions sterling in new 2¾ per cent. Consols has of course adversely affected the gilt-edged and the investment markets. Although there has not been the popular excitement over the present emission as was the case with the National War Loan 12 months ago, the public have readily subscribed to the new Consols, selling their other stocks where necessary in order to pay up in full whatever allotment may be made to them. The number of alterations to be found in our price lists this week is not large, but the majority are on the wrong side for holders. In contradistinction to this stands out a remarkable advance of 15 points in Commercial Cable stock. The strength of the American telegraph group is, however, offset by marked weakness in the Far Eastern division.

Shares in the electricity supply section are steady, with the exception of Metropolitans. Last Monday there came a sudden spasm of flatness in "Mets.," and the price tumbled to 10⅜, the lowest it has touched for years. From this there has since been some recovery, but the whole of the lost ground is by no means regained. The fall was brought about simply by the action of the St. Marylebone Borough Council in again promoting a Parliamentary Bill seeking for power to compete with the company, which, itself a substantial contributor to the rates, is thus threatened once more with rate-aided competition. There is the utmost indignation in the Stock Exchange market over what is regarded as an approach to confiscation, and it is observed that if the Marylebone authorities succeed in getting their Bill through, the number of others which will follow suit will practically kill all private electric lighting enterprise. But though the possible future is viewed with so much gloom, it should be noted that quotations in the case of companies other than the Metropolitan are not lowered. In fact, Bromptons are ¼ up, and City of London Debenture has gained a point.

Charing Cross Debenture stock has receded a trifle, the premium being now 1½ per cent. This is mainly due to the issue of the new British Insulated Wire Debenture issue, which is regarded as cheaper than the Charing Cross, and almost equally well secured. The interest on the latter is 4 per cent., while the British Insulated Wire Company offered ½ per cent. more. We are both surprised and sorry to see that only at the Liverpool office of the company can some of its most important papers be seen. Why not in London also? Barring this, the issue is a decidedly good one; there is a nominal market and premium of 2 per cent. already established. Dealings are, of course, for the special settlement.

We have already referred to the jump of $15 in the price of Commercial Cable stock, which now stands at 180. The buying that induced the advance has been on account of Uncle Sam, whose indiscriminate purchases, if they are continued much longer, will cause trouble hereafter. We should not be surprised to see Submarine Cables Trust certificates shortly taken in hand by the "other side." Anglo-American descriptions are steady, without much change. The Eastern brigade is dull; Eastern Telegraph Ordinary showing a decline of 3 per cent. on the week, while "China" shares are ¼ lower, despite the good report to which we referred last Wednesday. Two or three deceased accounts have lately somewhat swamped the market in Eastern Extensions, and one order alone was for the sale of 200 shares, which were disposed of in a line. Indo-European shares are down another £1, partly in sympathy with the Eastern securities. On the other hand, Great Northerns have gained a like amount, and there has been strong buying of the shares, the report being regarded as excellent in every way.

National Telephones are still being forced on an unwilling market, and the price is now as low as £3. The first and third Preferences are lower this week, and the 3½ per cent. Debenture stock can be picked up below 90. Fears of what the Government competition may effect are at the root of the market's flatness, which, perhaps, has now gone far enough. It must not be forgotten that the company is still doing well, and that many of its contracts have several years to run before expiry, whilst the State telephones can scarcely be ready for service until next year. Chili telephones are rather harder, but there is no change in Orientals.

Electric Railway securities are good, and there is a better feeling in regard to Metropolitan and District stocks now that the companies are beginning to show some signs of starting electrification. Districts are better at a shade below 30. Metropolitan Consolidated is much harder at 75⅜. British Electric Traction shares are saleable at 15⅛, and it is said that the Morgans are supporting the market. Miscellaneous shares show a slightly easier tendency. Telegraph Manufacturing have shed 10s. Thames Ironworks Preference are 15s., and the 4 per cent. first mortgage Debentures 93½ *ex* dividend. British Westinghouse Preference remain at 4⅜.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation April 17th.	Closing Quotations April 24th.	Business done during week ended April 24th, 1901. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	55 — 65	55 — 65	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	50 — 53 xd	50 — 53	51⅞	...
3,088,540£	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	94 — 96 xd	94 — 96	95½	95
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	8¼— 8¾	8¼— 8¾	8 9/16	8½
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3 — 3½	3½— 3¾	3 7/16	3¼
13,333,300$	Commercial Cable	$100	8 %	8 %	...	160 —170	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101½	100¾
16,000	Cuba Telegraph	10	8 %	7 %	...	7½— 8½	7½— 8½	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	16 — 17	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 — 104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	9¾— 10¼	9¾— 10¼	10	9¾
108,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	140 —145 xd	137 —142	141⅞	137
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94 xd	91 — 94	93	92
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	113 —117	113 —117	115½	113
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 14⅝	14 — 14½	14⅝	14⅛
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.)	10	...	...	...	13¾— 14¼	13¾— 14¼	13 15/16	13½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9⅜— 10½	9⅜— 10½	10½	9⅜
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾— 15¼	14¾— 15¼	15 1/16	14 15/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	33 — 35	34 — 35	...	...
82,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	45 — 49	44 — 48	47½	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3 — 3¼	2⅞— 3⅛	3 5/16	2 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	10 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	10½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¼— 4½	4 — 4½	4⅜	4
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	89 — 92	87 — 90	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	97¼	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7½— 8½	7½— 8½	8¼	...
3,381	Submarine Cables Trust	Cert.	...	...	...	121 —126 xd	120 —125	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½— 5	4½— 5	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13¾—14¼	13¾— 14¼	13⅞	13¾
75,000£	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	8%	...	⅜— ⅞	⅜— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	6 — 7	6 — 7	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8¼— 8⅝	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9 1/16	9⅛
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅛	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅝— 6¼	5⅝— 6¼	6	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	6 %	4 %	0 %	8½— 9½	8½— 9½	9	8⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	12½
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	8 — 9 xd	8 — 9	8½	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11 — 12 xd	11 — 12	11⅞	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	106 —109	106 —109	107½	106
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	5 — 5½	5 — 5½	5⅜	...
13,363	Do. do. 6 % Cum. Pref.	...	...	...	...	... — ...	5½— 6	...	...
75,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	103 —106	103 —106	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	10½— 11½	10½— 11½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 — 104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 1⅝	1½— 1⅝	1 11/16	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	3½— 4½	3½— 4½	4	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	11½— 12½	10½— 11½	12	10½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	110½	110
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	96 — 99	98½	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	16¼	15⅝
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	13½— 14½	13½— 14½	14¼	14
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	2 15/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	13 %	10½%	11½— 12½	11½— 12½	12⅛	11⅞

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation April 17th.	Closing Quotation April 24th.	Business done week ended April 24th, 1901. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	£10	...	...	...	7½ — 8½	7½ — 8½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	£10	6 %	...	...	15½ — 16	15 — 16	15 11/16	15¼
50,000	Do. do. 6 % Cum. Pref.	£10	...	...	...	12 — 13	11½ — 12½	12 9/16	12⅜
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	119 —122	119 —122	120½	120
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	1/16 — 3/16	1/16 — 3/16	...	...
50,000	† Do do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	1/16 — 3/16	1/16 — 3/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	£100	...	...	...	85 — 90	85 — 90	...	...
70,000	British Insulated Wire Ord.	£5	15 %	20 %	15 %	10 — 11	10 — 11	...	...
70,000	Do. do. 6 % Cum. Pref.	£5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	6¼	6 1/16
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	£2	5 %	6 %	...	1⅝ — 1⅞xd	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	£2	6 %	6 %	...	2 — 2¼xd	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	£5	15 %	15 %	...	15 — 16	15 — 16	15⅜	...
40,000	Do. do. 5 % Cum. Pref.	£5	...	...	...	5½ — 6	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	£10	...	...	...	9 — 9½	9 — 9½	9 7/16	9¼
78,703	Do. do. Pref. half-shares	£5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
78,703	Do. do. Def. do.	£5	...	...	...	4¼ — 4⅜	4¼ — 4⅜	...	...
855,000	City and South London Railway	Stock	2⅛ %	1⅞ %	1¼ %	46 — 50	46 — 50	47	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	£10	...	...	...	4 — 5	4 — 5	4¾	...
54,000	Crompton & Co., Nos. 1 to 54,000	£3	6 %	7½ %	...	3½ — 4	3½ — 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	£5	6 %	6 %	...	1½ — 2	1½ — 2	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	£5	6 %	6 %	...	3 — 4	3 — 4	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	£100	...	...	...	87 — 89	87 — 89	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	£100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	£2	6 %	6 %	...	1⅝ — 2¼	1⅝ — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	£2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	£10	7 %	7 %	...	10 — 11	10 — 11	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	£5	14 %	15 %	20 %	15 — 16	15 — 16	...	...
35,000	Do. do. do. 4½ % Pref.	£5	...	4½ %	4½ %	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	£10	10 %	10 %	...	21 — 22	21 — 22	21¼	21
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	£100	...	...	...	101 —104	101 —104	101	...
37,500	†Liverpool Overhead Railway, Ord.	£10	3½ %	3½ %	3½ %	7⅝ — 8	7 15/16 — 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	£10	5 %	5 %	...	13 — 13½	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	£12	15 %	15 %	17½ %	36 — 40	36 — 40	37¾	36½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	£100	...	... %	...	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	£5	8 %	12 %	...	11 — 12	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	£5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	£100	3 %	3 %	3 %	94 — 97	94 — 97	95	94

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 7/8—1/8.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, April 24th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£24	£25	£1 dec.
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5s.	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £130	£75 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed)	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£86	£84	£1 inc.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£84	£1 inc.
g ,, Rod	per ton	£85	£84	£1 inc.
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
c ,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/11	3/10½	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	45/4½	45/4	½d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£12 10s. to £12 15	£12 10 to £12 15	..
g ,, ,, Sheet	per ton	£15	£15	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£120 to £121	£120 10 to £121 10	10s. dec.
g ,, foil	per lb.	1/9	1/9	..
n ,, wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£40 to £70	£5 dec.
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8½d.	9d.	½d. dec.
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	6½d.	6½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5s.	£14	5s. inc.
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£21	£21	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yee & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE SUB-STATION MACHINERY.

By A. C. Eborall, Member.

(Abstract of paper read on Thursday, March 14th, 1901.)

(*Concluded from page* 686.)

Very great care must be taken to prevent oscillations in the relative motions of the generators running in parallel, with the consequent interchange of synchronising currents. Given well-designed engines, it will generally be found that the trouble, when it is present, is due entirely to the governors assisted by the momentum of the magnet wheels and by the attempts of the generators themselves to attain their proper phase relations; the cure for it consists in adjusting the governors in such a manner that they are absolutely unresponsive to very quick variations in the speed.

The reason is probably as follows:—If the governors are extremely sensitive, they will endeavour to compensate for the unavoidable momentary speed variations due, for instance, to the steam impulses. But the governor will overdo this, as is well known; a small relative oscillation of the revolving magnet wheels is started, which is increased by the lag of the governors in conjunction with the action of the periodic puffs of steam. These oscillations of the generators cause large synchronising currents to pass between the machines, and the oscillations reappear in the sub-stations, starting hunting of the motors or rotaries as above described.

The amount of the relative motions of the generators can be reduced to practically nothing if the governors can be prevented from responding to slight quick changes in the speed. Each engine governor should be fitted with a dash-pot of such a nature that no alteration will be made in the engine cut-off, unless the force acting on the governor is continued. Obviously the worst dash-pot to use is an air dash-pot; and the best a modified form of grease dash-pot.

It might happen, however, that this remedy in a particular case could not be applied for special reasons, and in this case the only remaining way of decreasing the amplitude of the oscillations would be to use damping-coils between the field-poles of the generators, as described in connection with the sub-station machinery. On very large slow-speed generating sets it is quite certain that it will pay to use such damping coils on the generators.

On account of the bending of the shafts, it is of importance with machines of very large size to arrange the generators in such a manner that they are unaffected thereby. Experience with such machines shows that no matter what size the shaft is made, the arrangement of the generators outside the engines is not so good from the point of view of parallel running as that of putting the generators between the cranks. The two cranks should preferably be set at an angle of 180° to one another.

The governing of the engines should not be too close. It is in general quite sufficient if the speed does not rise more than 2 per cent. when the load is decreased suddenly from full-load to half-load, or from half-load to no-load, and *vice versâ*.

The question of the permissible speed variation in one revolution or "cyclic irregularity" is an important one, for to a certain extent it determines the amount of metal that must be put in the rim of the generator magnet wheels. With a given type and speed of engine, the lower the frequency the better the parallel running, because a low frequency implies a smaller number of field-poles, and consequently the speed variation in the revolution causes a smaller phase displacement between the E.M.F. waves of the different machines in parallel, meaning smaller synchronising currents and greater stability of running.

For feeding rotary converters, which may be considered as being the most unfavourable case in practice, the phase displacement at any load should not exceed 2°; that is to say, a point on the rotating magnet wheel may not differ more than $\frac{2}{p}$ from the position it would have if the rotation was perfectly uniform, "p" being the number of pole pairs.

If the generators have a large armature reaction, the permissible phase displacement can be greater for the same synchronising current. With generators running in parallel one may be ahead and another behind by the amount of the maximum "cyclic irregularity," so that the amount by which the two E.M.F. waves are out of phase depends upon twice this; the synchronising current will be proportional to the sine of this total angle of phase displacement.

The variation in angular velocity during a revolution should be kept within the permissible limits with the minimum weight of magnet wheel; that is to say, the desired result should be attained rather by careful design of the engines than by very large fly-wheel effects. If this point be attended to, if the governor dash-pots are suitably designed, and if the pressure regulation of the generators is not too close, there will be no trouble from hunting either in the power station or in the distant sub-stations.

The "tachograms," A, B and C, fig. 9, are reproductions of the records obtained by means of a Horn tachograph from one of the 1,000-h.p. engines at Prague. The three records represent three different adjustments of the engine governor after the engine and generators had been erected. It will be seen that after the governor had been properly adjusted the total variations in the speeds does not exceed 0·3 of 1 per cent., or the "cyclic irregularity" of the engine does not exceed 0·15 of 1 per cent. up or down. The Horn tachograph is an accurate and extremely useful instrument, whose indications represent with sufficient accuracy what the engine is doing during the revolution. This is exactly what the electrical engineer wants to know in connection with the commercial problems of parallel running.

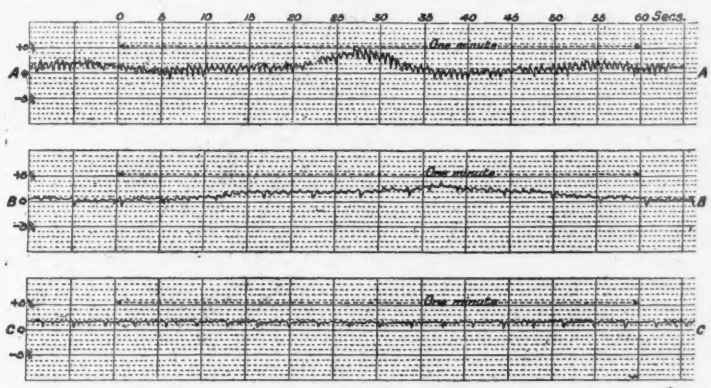


Fig. 9.—Tachograms of 1,000 b.h.p. Horizontal Engine.
Triple expansion; Two cranks at 90°; 90 revolutions per minute.

Comparison of Sub-Station Machinery.

Transmission: three-phase at 5,500 volts between lines and 40 cycles.
Distribution: three-wire at 510 volts between outers, neutral conductor earthed.

Type of equipment.	Asynchronous motor-generator.		Synchronous motor-generator.		Rotary converters and step-down transformers.	
Output of sub-station converter.	150 kw.	500 kw.	150 kw.	500 kw.	150 kw.	500 kw.
Speed of converter ..	480	300	480	300	480	300
Number of field-poles (generator).	6	10	6	10	10	16
Peripheral speed of commutator.	1,760	1,880	1,760	1,880	2,970	3,100
Number of commutator bars.	162	270	162	270	400	560
Temperature rise, any part after 24 hours at full load.	35° C.	35° C.	35° C.	35° C.	35° C.	35° C.
Rise of pressure when full load switched off, sub-station busbar pressure constant.	15 %	12 %	14·5 %	11·5 %	9·5 %	8 %
Efficiency { Full load	88·5 %	86 %	84 %	87 %	90 %	92 %
Efficiency { Half „	75·5 %	80 %	76 %	79 %	85 %	87·5 %
Overload capacity for 1 hour with fixed brushes.	25 %	25 %	25 %	25 %	50 %	75 %
Power-factor { full load	90 %	91 %	100-95 % (leading)	100-96 % (leading)	100-95 % (leading)	100-96 % (leading)
Power-factor { half „	87 %	89 %				
Starting current from A.C. side in terms of full load current.	80 % (rotor resistance)	50 % (rotor resistance)	100 % (Starting motor.)	100 % (Starting motor.)	80 % (Starting motor.)	60 % (Starting motor.)
Full load drop of speed.	3·5 %	3 %	None	None.	None	None
Relative cost per kilowatt, including regulating gear.	20 kw.	15·6	19·1	13·2	12·4 (Incldng. middle wire booster.)	13·0 (Incldng. middle wire booster.)
Floor space required per kilowatt (square feet).	0·8	0·5	0·75	0·5	0·55	0·45

III.—Relative Comparison of the Different Types of Sub-station Converters.

From the point of view of simplicity and ease of operation asynchronous converters are far ahead of the two types of synchronous machines. But this advantage is gained at the expense of plant efficiency, and consequently this type of converter is unsuitable for work of any magnitude. It will continue to find its chief use in connection with schemes where the total amount of power to be transmitted and distributed is relatively small, and where the converters do not exceed 150 kw. in size.

Synchronous motor-generators, on the other hand, are ideal machines for the work in many respects. High power-factors over the whole of the system are assured; there are no complications in working, and no parallel-running troubles need be feared, provided a fair amount of care has been taken with the design of the plant in the first instance. They can be operated equally well from circuits of any reasonable frequency. The second great advantage is that the regulation of the direct-current pressure can be performed in well-known ways with the greatest ease, and not only this, but the direct-current pressure is independent of the pressure fluctuations at the ends of the long, high-pressure feeders.

Both asynchronous and synchronous motor-generators are efficient types, and require simple switch gear.

Rotary converters are on the same footing with regard to starting and power-factor as synchronous motor-generators, and have two great advantages over either form of motor generator—they are 4 to 5 per cent. more efficient at all loads, and possess a greater overload capacity. They are, on the other hand, extremely sensitive with regard to parallel running; moreover, the arrangements for regulating and running are in general somewhat complicated, on account of the extra switch gear required for the step-down transformers and auxiliary devices.

With regard to the important points of floor space required and first cost, there is very little to choose between the different types of machines. Comparing the machines alone, there is, of course, a considerable advantage in favour of the rotary converter, but the additions to the latter equipment in the shape of transformers, air-blast outfits (when used), special regulators, and extra switch gear bring up the cost of a rotary converter equipment to very nearly the same figure as that for the synchronous motor-generator equipment; the asynchronous converter equipment is somewhat dearer than the latter as a rule.

The preceding table (see p. 729) serves to illustrate the above-mentioned points in a practical way. Examples given are taken from practice, and the machines (built in the same works) are compared upon *exactly* the same basis with regard to conditions of operation, such as speed, frequency, voltage, &c. The case selected is an actual combined lighting and power scheme, current for lighting purposes being taken from the high-pressure feeders *en route* to the sub-stations as well as from the latter—hence the frequency. The case is somewhat unfavourable to the motor-generators, as these machines were arranged with a generator at each end of the motor shaft, having half its output; consequently the floor space required is greater and the cost more than would have been the case had each motor driven a single generator of equal output.

It will be seen that with the larger machines the only substantial advantages of the rotary converter compared with the synchonous motor-generator are those of greater efficiency and overload capacity. These are, of course, of very great importance, but for many purposes the greatly superior performance of the synchronous motor-generator from the points of view of simplicity, parallel running, and pressure regulation must be carefully balanced against them.

It is not too much to say that the limit of successful operation of rotary converters is reached at 40 cycles; above this frequency in all cases the best type of converter is the synchronous motor-generator. Above the frequency of 40 cycles good parallel running of the rotaries becomes extremely difficult, the machines hunting at the slightest provocation, and the question of commutation becomes a very difficult one to solve in a satisfactory manner. As already pointed out in connection with the generators, the lower the frequency the better the parallel running, for with a given angular displacement the phase difference between the E.M.F. waves of the various machines is smaller.

All the features, common more or less to the high-frequency rotary, namely, crowded poles, high peripheral speeds, high armature reaction, thin commutator segments, high voltage per bar, short distance between brush holders, &c., are wholly unfavourable to successful parallel running and good commutation, to say nothing of the increased wear and tear due to abnormally high speed. It is for this reason that a frequency of 25 cycles has been standardised for rotary converter work, and at this frequency the machines are undoubtedly satisfactory. Between 30 and 40 cycles their performance is still good under favourable conditions (that is, proportionately better engines, high speeds and low voltages), while above 40 cycles the use of the rotary converter, in units of large size, would appear to be practically out of the question.

Low frequency of operation, such as 25 cycles, while satisfactory, if the whole output of the power station is to be absorbed by the converter sub-stations, is undesirable if other work has to be done in addition. Modern practice has shown that a frequency of 40—50 cycles is the best that can be employed for the work in question; a departure from this in order to suit the requirements of the rotary converters constitutes in itself a disadvantage which is not present when motor-generators are used for the same work.

Concluding Remarks.

Given that it is required to convert polyphase current into direct current by means of converting sub-stations, it is possible, based upon the considerations noted in the paper, to draw the following general conclusions:—

1. For power work, and for those cases where the amount of lighting to be done is relatively small, rotary converter sub-stations operated at 20—30 cycles are preferable.

2. For lighting work the use of motor-generators, operated at 40—50 cycles in the sub-stations, will give the best results.

3. Of the two classes of motor-generator sub-station that equipped with asynchronous machinery is on the whole unsuitable for work of any magnitude.

The above conclusions must not be considered as being perfectly definite, on account of the widely different conditions that are met with in modern practice. Finally, the author would like to suggest in this connection that the discussion might profitably include the broad question of the transformation and distribution of large amounts of polyphase current for supply over large areas, for it is one of the most important questions of modern electrical engineering. Although in many cases direct current sub-stations are undoubtedly advisable, still in many cases the direct distribution of polyphase current from simple transformer sub-stations, will undoubtedly be the best solution, not only from the technical, but also from the commercial point of view.

NOTE ON THE USE OF THE DIFFERENTIAL GALVANOMETER.

By C. W. S. Crawley, Member.

(*Paper read April 18th*, 1901.)

I do not wish to suggest that I am bringing forward anything new, but rather to say a few words in favour of an old but very effective instrument, which has fallen into disuse, and to show a practical way of using it for modern work.

In early days the differential galvanometer was used a great deal; when the bridge came into general use it was shelved, as the scope of the bridge was so much greater, and it sufficed for all the resistance measurements then required. Another reason why the differential galvanometer went out was, I think, this: People were used to the old pattern of differential galvanometer with pivoted needle, which was adjusted once for all and remained right. Then the reflecting galvanometer became universal, and the reflecting differential galvanometer when adjusted does not remain right for good, but must be very carefully levelled, and even then is seldom in perfect adjustment. Some year or two ago I wanted some low resistances adjusted which it was impossible to bridge, and so I looked into the potentiometer, which was better, but very troublesome, and this brought me to the differential galvanometer. For I always look on the differential galvanometer as a potentiometer; only, instead of balancing opposing E.M.Fs., one balances the M.M.Fs., caused by them.

Now, I knew by sad experience that to adjust a differential galvanometer was a very great nuisance, so I took the bull by the horns and did not adjust at all, but simply had the galvanometer coils wound double, *i.e.*, with twin wire, and set the instrument up as it was, without adjustment.

In fig. 1, *a* and *b*, 100 ohms each, are the circuits of the differential galvanometer in parallel, opposed, joined to the battery. In the circuit of *a* is a 0·1 ohm resistance, which can be cut out by a key, and also a slide-wire resistance, s, of about 1·5 ohms. In circuit with *b* is enough resistance to about balance. This can be a resistance box. When joined as shown, if *a* or *b* predominates and

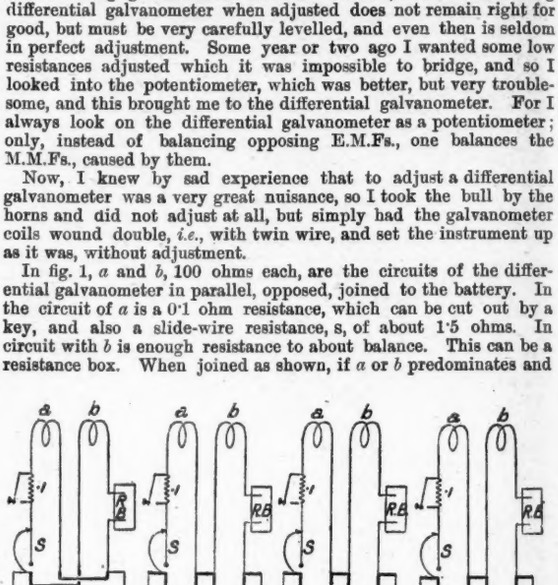


Fig. 1 Fig. 2. Fig. 3. Fig. 4.

gives a deflection, sufficient resistance is added or subtracted by the slide wire till the spot roughly comes to zero. Now depress the 0·1 key; this disturbs the balance by 0·1 per cent. and causes a deflection of some hundreds of scale divisions. If we do not want to read closer than ·01 we need not adjust the balance closer than, say, 10 scale divisions.

We now know that two equal and opposite E.M.Fs. at the terminals of the two-coil circuits will balance, so that we can compare any two equal coils with great ease and great accuracy. For example, two ·001 ohm coils, as in fig. 2. If they are not alike there is a deflection. Pressing the 0·1 ohm key gives the deflection for 0·1 per cent. difference between them, which, with only 10 amperes through them, is about 400 scale divisions, so when working to ·01 per cent. anything under, say, 10 scale divisions can be ignored (which is a great comfort when adjusting).

But we can go a great deal further; we can join up on to the terminals of a 1 and a 10-ohm standard coil as in fig. 3, and add resistance to *b* circuit till a balance is obtained. For all-round work an ordinary resistance box will do, but if there is much 10 to 1 work to be done it is sometimes worth having a separate coil of 9 *b* ohms. It was in this ratio way that I used it first; I wanted a set of stretched copper wires, accurately adjusted, for copper conductivity work, of 1, $\frac{1}{2}$, $\frac{1}{4}$, &c., down to $\frac{1}{1024}$ ohm. This would have been impracticable by bridge, and very inconvenient by potentiometer.

But setting the differential galvanometer two to one it was quite easy, the first or one ohm coil being the most difficult, as it had to be done against an outside standard. And the checking is so simple; the galvanometer is set, say, 4 or 8 to 1, and every third or fourth wire compared in the same way.

At a pinch one can go a little further still; a coil differing considerably from the standard can be balanced by adding resistance to *b* coil and allowing for it, or setting to an odd ratio; but this is more troublesome.

Now, as to sensitiveness. With 0·1 volt at the terminals of coils short on to the galvanometer and a 10 second swing, we have a deflection of 450 scale divisions for a difference of 0·1 per cent., so that we can compare two $\frac{1}{1000}$ ohm resistances with only 10 amperes and have a deflection of 4·5 scale divisions for ·01 per cent.

As to limits of accuracy and sources of error, the galvanometer can be balanced far beyond anything required. Next the question of perfect contacts; they can certainly be counted on not to be more than $\frac{1}{1000}$ ohm if made rationally, or an error of ·001 per cent.

As to temperature, the galvanometer coils are copper, but being wound double remain always at the same temperature.

Thermal contacts may occur at times, but are easily detected and eliminated by reversing the battery current. They are infrequent and small in effect.

For long and continuous testing, especially with a ratio, I like to have a rocking mercury switch which will do the check instantly. When working with ratios, temperature may cause an error; but if the galvanometer is placed so that its temperature remains constant, as shown by a thermometer, the error will not exceed 0·2 per cent. A check should be made at the end of the test.

In setting, it is, of course, necessary to allow for errors in the standards, if they would be within the limits required. It is easily done by deflection.

There is only one inherent error to allow for. That is due to the resistance of the coil circuits of the galvanometer not being exactly the same when they are in balance. This, however, is but small.

If the coils differ by a per cent. and they are b times the resistance of the coils under test, the error in the result is $\frac{a}{b}$ per cent. a should be under 1, and b is generally at least 100, so that at the worst the error is ·01 per cent., even when comparing 1 ohm coils or setting 1 to 10 ratio with 1 to 10 ohm coils.*

On the table there is a potentiometer which I designed some time ago to get rid of a slide wire, and which is used a good deal now. There are two dials, one of about 16 ohms divided into 150 equal parts, and the other, the whole of which is equal to one coil of the first dial and divided into 100 parts, thus giving the equivalent of a slide wire divided accurately into 15,000 parts, which is ample for practical work, and which cannot be damaged by its natural enemies, wear, pupils or students. It can also be speedily checked, right through, against itself.

Now, just think of the labour of adjusting the 150 contacts of about 0·1 each; and still worse the 100 contacts of about ·001 each by potentiometer or other such means. But by differential galvanometer it is perfectly simple; and the result can be easily checked, as pointed out before, by setting the galvanometer 2 or 3 or 10 to 1 instead of level.

I have also on the table another use of the differential galvanometer method. It is shown diagrammatically in fig. 6. It is a workshop method of measuring anything between ·1 and ·01, or even less.

In the diagram there is a slide wire of ·1 total in series with the resistance under test and a battery. One coil of a differential galvanometer is applied to the ends of the resistance R by means of stabbers on cords; the other coil is joined to one end of the slide wire and to the sliding contact, so that it takes the fall over more or less of the wire, the whole length of the wire being divided into 1,000 parts by a scale; each division (about 1 mm) is equal to ·0001 ohm. The wire is about 0·1 in. diameter, so wear does not come in. It works well with 5A.

In conclusion, I do not suggest the differential galvanometer for ordinary accurate coil work; the Carey Foster method is perfect for that, and I have never sanctioned any accurate coils between 1 and 10,000 being finally tested by any other method. But below 1 ohm it is invaluable, and it makes quite easy a good deal of special work which would not be practical commercially by any other method.

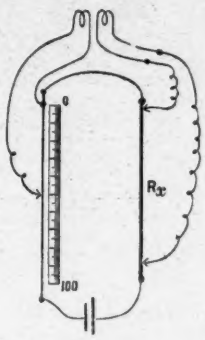


Fig. 6.

For example, the conductivity of two copper bars can be compared with quite reasonable currents, say 10 amperes for bars 1 in. square, which gives about four scale divisions for ·1 per cent. with contact points 12 in. apart.

* Let the two coil circuits be so adjusted by resistance that in parallel they give no deflection.

Then equal E.M.Fs., at their terminals, always give none.

Now join to the terminals of two equal coils, D, in series.

If the galvanometer circuits are of equal resistance there will be no deflection.

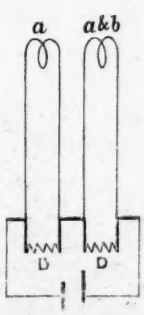


Fig. 5.

But if they are not, but are a and $a + b$ respectively, the E.M.Fs. on them will be proportional to the joint resistances and there will be a deflection due to the difference of E.M.F. on the two. The joint resistances are—

$$R_1 = \frac{a\,d}{a+d} \text{ and } R_2 = \frac{(a+b)\,d}{a+b+d}.$$

Let $b = \frac{a}{p}$ and $d = \frac{a}{q}$; substitute, and we get

$$\frac{R_2}{R_1} 1 = + \frac{1}{p+q+p\,q}$$

p and q are large—at least 100; so that error is practically $\frac{1}{p\,q}$, *i.e.*, if the coils circuits differ by C per cent. the error in the result is $\frac{C}{P}$ per cent., which is of the order of ·01 at most, and can be easily allowed for in setting.

FRENCH TELEGRAPHISTS.

[FROM OUR OWN CORRESPONDENT.]

Paris, *April 15th.*

On Thursday, April 11th, the French Telegraphists' Association held its first annual Conference in the Grande Salle des Sociétés Savantes, 28, Rue Serpente, Paris. The Association was formed in October last, and has been recognised and encouraged by M. Millerand, Minister of Commerce, Industry, Posts and Telegraphs, and M. Mougeot, the Under Secretary of State for Posts and Telegraphs. The Conference was attended by nearly 1,000 delegates hailing from Paris, Marseilles, Lyons, Bordeaux, Toulouse, Lille, Nantes, Carcassonne, St. Etienne, Perpignan, &c., and many ladies were included in the number. The general secretary, M. A. P. Lemaitre, in his opening speech, recounted the history of the Association, and amid tremendous applause spoke of the assistance and encouragement rendered by M. Millerand and his colleagues in the administration. Dealing with the financial position of the Association, M. Lemaitre said it was very satisfactory. There had been a total of receipts amounting to 5,307 frs. and an expenditure of 2,070 frs., leaving a balance on the first five months of 3,237 frs. The membership was given as follows:—On January 10th, 1901, the number of members was 1,288, on January 31st it had increased to 1,569, on February 28th it was 1,983, whilst for March 31st the total stood at 3,028, showing that during the last six weeks the number had nearly doubled. Thanks to the administrative encouragement, applications for membership were now literally raining in. The treasurer then gave details of the finances, and then M. Veillet-Deslandelles presented the report of the Studies Committee. This Committee has for its functions to study the technical side of all questions of interest, and advise the Administrative Committee in matters of detail.

The report was exceptionally interesting. Among the matters dealt with were the question of granting to postal employés a ticket enabling them to enjoy at all times the privilege of travelling at half rates on the railways. This privilege is already enjoyed by the postal employés of Italy, and is granted at holiday times to French employés. The Minister has taken the matter under his consideration. The Committee also reported an interview with the Minister on March 20th last for the purpose of laying before him proposals for the reform of the Disciplinary Council. This Council is the Administrative Council resolved into a tribunal for the purpose of dealing with grave breaches of departmental discipline upon which local chiefs are not allowed to decide. Complaint was made to M. Millerand that the accused employés, whose cases were dealt with, were not permitted full opportunity for defence. They were kept without information concerning the details, and sometimes even the subjects, of the charges upon which they were tried, the decision of the Disciplinary Council being arrived at upon *ex parte* statements from the employés' superior officers. It was pointed out that it was necessary that the utmost reliance should be placed in the impartiality of the decisions of this Council, and in order to secure this the following proposals were made to M. Millerand. First, that all documents in the case should be read by the accused, and he should be allowed to make a final reply before the papers came before the administrative Disciplinary Council; second, that the accused should be allowed to appear and plead his own case before the Council; and third, that a member of the Administrative Committee of the Association should be a member of the Disciplinary Council. It was stated that M. Millerand

was impressed favourably by the proposals, and an early reply is expected conceding the demands. In America the National Union of Letter Carriers have the right of sending their president to plead for any members of their organisation accused of breach of discipline. He is accorded all the rights usually accorded to counsel in a Court of Law, and it is stated that the practice gives satisfaction both to the department and the employés.

After the report of these interviews, the Committee laid its programme for the future before the conference, and received warm congratulations and thanks.

A resolution was passed in favour of a weekly day of rest for all employés, and other matters of lesser import were dealt with. During the evening telegrams of congratulations were received from many places, among them being a telegram from the London branch, Postal Telegraph Clerks' Association. A hearty vote of thanks was passed to the English Association for its aid and sympathy.

THE RATING OF ELECTRIC LIGHT AND POWER STATIONS.

[Note.—Our attention has been drawn to the fact that in our second article on the above subject, which was published in the Electrical Review for April 5th, 1901, we made use of the Canterbury Valuation as an illustration, without mentioning that it had already been published by Mr. Spencer Hawes, A.M.I.E.E., in an article "The Rating of Electric Supply Undertakings," which appeared under his name in the columns of a contemporary some time back. We omitted to make the customary acknowledgment through pure accident, and much regret that it should have caused him any annoyance.]

(*Continued from page* 579.)

Upon the "Expenditure" side of the account, there are one or two items to which attention should be directed. Under the heading "Salaries," fees payable to directors may legitimately be included. It has been urged that the hypothetical tenant would not pay directors' fees, but it is obvious that if an undertaking were carried on without the aid of a board of directors, whose expert advice is often so valuable, it would be necessary for the undertakers to increase their staff, and spend large sums in making that increase. Moreover, the fees of directors were allowed in the Southampton Docks case (1851), 20 L.J.M.C., 155; 14 Q.B., 587; 6 Rail. Cas., 428; 16 L.T.N.S., 460; 15 J.P., 145, and in the London Tramways Company *v.* Lambeth (1874), 31 L.T., 319. With regard to repairs, it will be seen that in the valuation marked I. (*ubi supra*), these are put under the head of tenants' expenditure, while in Example II., which, as we have pointed out, is an actual valuation of an electric lighting undertaking, the repairs have been entered under the head of "Statutable Deductions." It is obvious that in entering the cost of repairs under the heading "Statutable Deductions," the Assessment Committee regard such repairs as falling upon the landlord. In such circumstances the hypothetical tenant would obviously be prepared to give a higher rent, than if the whole burden of the repairs were to fall upon himself.

In actual practice, however, the committees very often assume that the whole burden of repairs and renewals falls upon the tenant, and in such case they are included under "Tenant's Expenditure," as in Example I.

Under the heading "Rates and Taxes" would be included the "rate," the amount of which it is the object of the committee to assess. Income-tax, according to some authorities, should not be deducted, "as it is a mere personal matter." The question of apportionment of rates where the undertaking is situated in a number of distinct parishes or rating areas, is dealt with hereafter. Under the heading "Law Expenses" would be included the cost of any necessary litigation. This is an item which may be subject to great variation.

It next becomes important to differentiate between landlords and tenants' capital. The tenant's capital is practically equivalent to the working capital referred to in Example I. (*supra*), and in order to find the tenant's share, interest at 17½ per cent. must be deducted from the tenant's capital. In gasworks it is generally considered reasonable to make allowance for a six weeks' stock of coal—for the reason that some unlooked for catastrophe might involve enormous expense if the undertakers placed absolute reliance upon the continuity of a daily supply.

The *meters*, although they are chattels in the eye of the law [Reg. *v.* Lee, L.R., 1 Q.B. 241; 35 L.J. (M.C.) 105], are regarded by the rating authorities as part of the working capital, and are generally reckoned under the head of "Tenant's Capital." Their value should be estimated at cost price, and no allowance should be made for depreciation, for unless a meter is as good as new it is quite useless to the company. It is sometimes said that an allowance should be made for depreciation, but it is worthy of remark that, no matter what the age of a meter, so long as it works efficiently, the same rent is charged to the consumer.

One Quarter's Rent.—This item is included under the heading "Tenant's Capital" on the ground that a tenant must be presumed always to hold one quarter's rent in readiness. This would avoid his keeping a sufficient sum in reserve to meet the demand of his landlord. The inclusion of this item is often fiercely contested by the Assessment Committee, and the case of R *v.* Parrott (5 T.R., 595) is cited as an authority for the proposition that rent in suspension should not be included under tenant's capital; but, in reality, that case decided that the lessee of a coal mine is liable to be rated to the relief of the poor although he derives no profit from the mine.

Charges on Tenant's Capital.—The figure, 17½ per cent., is made up as follows:—

10 per cent. for trade profits,
5 per cent. for interest on capital hung up,
2½ per cent. for risks and casualties.

The above percentages are almost universally accepted in the case of gasworks, and were, in fact, adopted by the Recorder of Canterbury when he was reviewing the assessment of the electric lighting works for that town (*see* Example II. *ubi supra.*) It would seem a little inconsistent to allow for a profit of 17½ per cent. upon the undertaking of a local authority whose profit-earning power was restricted by their provisional order or special Act. It has been definitely settled that where the profit-earning power of such a body is limited, the hypothetical tenant must be over-looked in making the assessment, and the rate should be based upon the actual, and not the possible, earnings of the undertaking. (*See* The Droitwich Union Case, post.) This interesting point does not yet appear to have been raised, but it may be expected at any moment.

The allowance of 2½ per cent. is intended to cover risks of fire, &c., to which the property of the tenant is exposed, and to defray the cost of insurance against accidents to workmen. In view of the increased liability which the Workmen's Compensation Act of 1897 has thrown upon employers of labour, the allowance of 2½ per cent. would seem to be scarcely adequate for modern requirements.

Statutable Deductions.—Upon reference to Examples I. and III. *supra*, it will be noticed that in Example I. the actual amount spent on repairs is deducted from the receipts under the heading of expenditure on the part of the hypothetical tenant, while the statutable deductions are confined to renewals and insurance. In Example III., on the other hand, all these items are placed under the heading "Statutable Deductions," with the result that, instead of an allowance being made which is actually equivalent to the cost of the repairs to which the tenant has been put, a definite percentage is allowed to be deducted from the landlord's capital to cover all such risks.

Inasmuch as Example III. relates to the valuation of an electric lighting works, it is conceived that this method of dealing with statutable deductions best commended itself to the Recorder of Canterbury. Deducting the "tenant's share" from the net receipts, we ascertain the "gross value" or "gross estimated rental." Deducting the statutable allowances from this figure we arrive at the rateable value.

Statutable Allowances.—There is some doubt as to what should come under the head of "Statutable Deductions." A further question may arise in connection with electric supply works. It is provided by the Electric Lighting Act of 1888 that within six months after the expiration of 41 years from the date of the provisional order the local authority shall have power to buy up an entire installation at cost price without any allowance for goodwill. In order to provide against the loss which may ensue from such compulsory purchase without allowance for goodwill, a supply company is compelled to set apart a certain sum each year. The question arises, therefore, are the company in making the statutable deductions entitled to deduct therefrom the sum which they set aside in each year to make good a prospective loss of goodwill?

This question has not yet arisen in the Courts, but will probably come up on the first possible opportunity. In the writer's view, the amount in question cannot be written off by the tenant under the head of repairs and renewals, for the hypothetical tenant pays rent upon a tenancy from year to year; and the contingency of being sold up could not affect a mere yearly tenant at any rate until the fortieth year.

Whether such a sum could be written off by the hypothetical landlord as a statutable deduction is more difficult to decide. It is clearly allowable to incur any expenditure which is necessary to keep the hereditament in a fit state to command the rent; but it is not certain that the transfer of the entire undertaking at cost price to a new proprietor would materially lessen its rent-earning capacity.

For the purpose of ascertaining the correct amount of statutable deductions, the life of generating plant, mains, transformers, accumulators, &c., employed in an electric lighting installation may be taken to be 25 years. The life of the buildings may be estimated at about 50 years, and consequently the allowance made in respect of them should be somewhat less. Such a computation is based upon the structural value of the hereditament, and in order to check the accuracy of an assessment based upon the structural value, it is customary to have regard to the actual capital of the company. Subtracting from that figure all that will not require reproducing, *e.g.*, such items as goodwill, the cost of obtaining Acts of Parliament, and the value of the site; and all mere chattels purchased in the course of business, the figure which remains should represent the amount spent on buildings, machinery, apparatus, plant, mains and services.

Instructive examples of valuations of gasworks, which cannot fail to be of use to those who are concerned with the assessment of electric lighting undertakings, may be found in South Metropolitan Gas Co. *v.* St. Olave's, Ryde's Met. Rat. App. 305; Gas Light and Coke Co. *v.* City of London Union, Ryde's Rat. App. (1891—1893) 204; and in R. *v.* Lee (1866) L.R., 1 Q.B. 241.

Apportionment between different Parishes.—A difficult question arises when the generating station is in one parish and the wires, mains, and consumers' fitting are spread over a number of parishes in the neighbourhood. In a case of this kind it would be manifestly unjust to apply the ordinary "profits" rule which has already been described; for if the earning power of the plant in each parish were alone to be regarded, it is clear that the parishes in which the current was actually supplied would pay the increased

rate, whereas the parish in which the generating station was situated would be unable to have that station valued according to the profits indirectly earned by it elsewhere.

(To be continued.)

HINTS TO THE SMALL ROAD SUPERINTENDENT.*

By "ECONOMY."

There are so many items which cause a road to be non-paying that to enumerate all would require a very extended amount of space, but my intention is to speak of a few which affect smaller roads in particular.

Street railways should be conducted on the same businesslike methods used by any prudent, yet progressive, wideawake man in any other business enterprise, and a management should therefore place a person of experience in street railway work in charge. It may be necessary to pay such a person a larger salary than by employing an inexperienced person, but if he attends strictly to business he will save the difference in salary several times over in a short time.

One thing should always be borne in mind, and that is the old saying, "A stitch in time saves nine," for if you keep everything in thorough repair your expenses for repairs will be less at the end of the year than if small things are neglected and then overhauled when they get so bad that you must repair them.

Commencing at the root of a railway, we have the boiler room to consider. Here is one of the largest items of expense, and every effort should be made to hold the expense down. To accomplish this careful tests of various kinds of coal should be made, and only such giving the best results at least expense should be used. Because a certain coal can be purchased at 50 cents or $1 per ton less does not always signify that it is the cheapest. Then the boilers should be kept clean, grates and fire boxes kept in repair, &c. I have found boilers in which the flues were so plugged up that not over one-half of their diameter was working, and where the condition of the walls, grates and fire boxes were in such shape that, after giving the place a thorough cleaning up, the amount of coal used was reduced to exactly one-half of what it formerly required. A competent, careful engineer can save a considerable amount each year in the matter of repairs, oils, &c., and by closely watching all steam pipes and repairing leaks as soon as they appear.

Then comes the car equipment and repair shop. Next to irregularity of car service, nothing so much affects riding as noisy, dirty and ill-kept cars, yet here you can save a large sum annually, if properly cared for. In the first place, it does not pay to use ancient, out-of-date motor equipment, for various reasons. To illustrate this, I will give one of my personal experiences in this particular.

Taking charge of a road some years ago, I found they were using three different kinds of motors, and of these the larger number were of old and out-of-date pattern, with ring-wound armatures. To keep going, we were obliged to carry a stock of repairs for each kind of motor used; or, if a car came in, it remained in the car house until we could get repair parts. I found that we could "scrap" these motors (to sell them as motors being out of the question), and for every three of them could buy second-hand, thoroughly overhauled, late pattern, formed coil motors of twice the horse-power of the old motors, yet it was a difficult matter to convince the owners of the road that in the long run they would be saving money. The repairs on the old motors were numerous, and, being out of date, parts could only be obtained "on special order," and every street railway manager knows what expense that causes. Or, if we could not dispense with this style motor, we could get motors of a later style and use these motors under extra cars, by putting two under each car, thus reducing the liability of overcrowding them, and thereby saving the life of the motors.

For a small or medium-sized road it pays best to standardise the equipment and have it as near up to date as possible.

A road should also be equipped with sufficient machinery and tools to do all ordinary repair work. It does not cost much to have your own forge and anvil, drills, &c., and the bills you pay a machine shop for every little piece of work done by them will make a nice little item of saving during the course of a year.

For a small road it is a considerable advantage to have the various trades represented among your car men. My experience has been that, having a blacksmith, carpenter, painter and fireman on the line, who can be called in when necessary to do such work, considerable time and expense can be saved. Excellent men in these lines can often be secured as carmen, even at less wages than their trade pays, as it gives them steady employment, which is not always the case while working at their trade.

Then every piece of scrap, no matter how small, should be saved and kept in a place prepared for it. To find scrap copper, brass, or iron scattered all over the place, shows a lack of watchfulness, and results in losses to the company.

The necessity of keeping the track and bond wires in good condition every man realises, if for no other reason than to save the complaints from the public. The financial gain from this source is a considerable item, as a poor track injures trucks, motors and cars, besides keeping a good many from riding. The importance of keeping the bond wires in thorough repair cannot be over-estimated. It saves power, and lessens the liabilities of burn-outs on motors.

Then the poles, span and trolley wires should be kept in proper repair. Rotten or weak poles should be replaced before they "come down" themselves. I advised the officials of one road to replace six old poles with new, but they stated that they "could not afford to buy new poles at present." One week later a trolley pole jumped, and striking a span wire, brought down all six poles. One pole struck and demolished the top of a car, and when the owners of the road got through with their repairs, they found that they had saved one week's life on the poles, but had lost enough to pay for setting new poles over a mile of the road.

You can stimulate traffic to a certain extent, but you must not disappoint the public by giving a good service on a line to or from a park or pleasure resort and then compelling the people to walk home from a central point, owing to the absence of the regular cars.

The matter of passenger traffic has been amply discussed in the *Street Railway Journal* heretofore, so that I can only add, "Watch every point about the road, and see that no unnecessary loss occurs through neglecting promptly to repair the smallest matter."

A dollar saved is a dollar earned, and if you keep a careful watch to get every possible nickel for fares, and also watch your expense account, you will find it will soon result in an increase in net earnings each year. To carefully look after either one and neglect the other is only attending to half of the business. By watching your expense account, I do not mean you should cut down necessary items, but see where improvements can be made which will be the cause of *reducing* the general expenses.

* *Street Railway Journal.*

SOME SWISS ELECTRIC TRAMWAYS.

In the April issue of *Traction and Transmission*—the special monthly electric power publication of our contemporary *Engineering*, we notice an article by Mr. J. S. Edstrom upon "Electric Tramway Practice in Switzerland,"

Compressed as it is into a space of less than 2½ pages, it is obvious that the author of this article could not enter into very minute particulars or attempt to treat the subject in any other than a "pithy paragraph" style. He has, however, enlivened it by means of some attractive illustrations of typical generating plant, cars, and car sheds, &c., which will doubtless duly impress the reader.

Amongst the points worth notice in the article may be mentioned the following. Mr. Edstrom speaks of the Swiss tramways as being under the "control" of the Government, but this presumably can only be in a fashion somewhat similar to the "control" exercised in this country by the Board of Trade, in regard to inspection and regulations for construction, working, &c.

There are, however, some striking differences in the ruling conditions—the mere mention of which will be enough for British traction engineers. Thus, for instance, we are informed that in Switzerland, suburban tramways have feeders of bare copper supported on the poles. The only thing of the kind permitted with us are the bare copper wires which we also incidentally use as trolley wires! Then again, it is stated that the overhead wire system is sanctioned on the finest streets and quays in the principal Swiss cities.

Anyone, who travels even a little abroad, knows well what is allowed in this respect, but even to-day the stay-at-home town councillor who prates of electricity being in its—you know the rest—also finds serious objection to the appearance of overhead wires on the dirty dingy streets of his beloved native town.

Span wire construction is used wherever possible, and the consent of property owners does not appear necessary, though compensation to the tune of a few pounds is paid to them. So far as we know, the city of Glasgow is the only place in this country where span wires can be attached to buildings without leave or license or payment of any compensation; and that is solely because the Corporation obtained Parliamentary powers when possibly Jupiter was nodding.

Again, a somewhat higher voltage is permitted in Switzerland than with us—viz., 600 volts in the towns and 750 outside. A 50 per cent. increase enables a good deal more to be done in the way of running longer distances from the power house, or dealing with more traffic on a given amount of capital outlay upon feeders. There is no rule as to the drop of voltage in the rail return, but only a small minimum current capacity for the bonds at each rail joint. Return cables must also have the same section as outgoing feeders.

Somewhat curious expressions are used in the article. Underground feeders, for instance, are said to be laid in "pottery conduits filled with sand." The rails in Geneva (Phœnix girder pattern) are stated to be laid direct on concrete "blocks" about 8 in. by 12 in. cross section. Surely these should be "longitudinals" or "beams" rather than "blocks"; the day of stone blocks or sleepers passed by several generations ago.

It is interesting to note that the telephone guard wires are of heavy steel, earthed to the track. They are said to have large current-carrying capacity, so that if a telephone wire breaks and falls on to the guards and trolley wires the telephone wire is the one to suffer by melting. Telegraph and telephone wires are, in the case of new lines, bunched together so as to cross the trolley wires at as few points as possible; the expense of this is borne by the tramway company.

The cars illustrated are all of the familiar Continental single deck

type, but the Swiss must be more democratic than their neighbours, as there is apparently but one class provided.

The car barns shown—Lucerne and Zurich—are provided with hand traversers. This seems a little behind the times, and must entail some wasted hours and energy compared with the results given by electric traversers, of which appliances there are plenty elsewhere to be seen.

A good feature to be recorded, however, is the heating of the car sheds in winter, also the Government regulation which calls for bath rooms and special clothes-drying rooms for the employés.

Lastly, the author speaks of turbines driving generators direct, and refers to plate No. VII. illustrating his article. This plate represents a sub-station with rotary converters, the alternator of which is perhaps not so unlike a turbine in external appearance as to deceive even a printer's eye! The slip, however, will be obvious to all.

THE SOLDERING OF ALUMINIUM.

During the past few months there has been a regular revival of interest in the soldering of aluminium, and many of the papers have been busily engaged in discovering and describing novelties which are several years old, while others have been carefully giving a wrong or imperfect explanation as to why aluminium is so difficult to solder with perfect success. Although we do not by any means intend to imply that aluminium can ever be soldered with the ease and despatch with which that operation is conducted on brass, galvanised and tinned iron, yet the metal is capable of being united by the bit somewhat more readily than most people seem to imagine, provided a proper kind of solder is employed in the proper kind of way. There are two totally distinct obstacles to be overcome before a satisfactory joint in sheet aluminium can be made by soldering. The first is to find and use some material which will be permanent in damp air, water, &c., when it is in good electrical contact with so electro-positive a metal as aluminium; the second is to apply that material to a metal like aluminium, which is always covered with so closely adhering and rapidly growing a film of oxide. Now, it is clear that the stability of the soldered joint on exposure will depend entirely on the composition of the solder adopted; but the ease of application of that solder will depend partly on its own composition, and partly on the initial preparation of the aluminium surface.

To make a valuable solder, then, four points have to be considered. It must be composed of some metal or alloy which fuses at a low temperature, so that it shall flow smoothly from a copper, nickel, or aluminium soldering bit. It must not oxidise appreciably nor segregate when heated to its melting point on the bit. It must, as a whole, be as electro-positive as possible, so that it may not be capable of forming with the aluminium object to which it is applied a galvanic couple of sensible voltage. The fourth requirement concerns the aluminium surface itself; it must be cleaned from its film of oxide either by mechanical or chemical agency during the act of soldering, that is to say, while the metal is protected (if possible) by the molten solder from the surrounding atmosphere. The selection of a metal or of several metals to form an alloy of any desired melting point is not a matter of great difficulty. Many such compositions have been used for soldering other metals for generations; there is no particular trouble in finding something to match the peculiar shade of white exhibited by commercial grades of Héroult aluminium so that the joint may not be conspicuous to the eye. The question of galvanic action between a metal and its solder, on the other hand, has scarcely ever been of much practical importance hitherto; and our practical metal workers are rather apt to overlook or ignore the necessity for investigating the matter now that aluminium has become of industrial significance. This is only natural; for with due skill the coating of oxide on aluminium can be removed, and almost any well known solder stuck on to the metal, thus forming a joint which for an hour, day, or week appears perfect, has perhaps greater mechanical strength than the aluminium itself, and conclusively demonstrates to the happy inventor that he has discovered another "fortune." In a month or so, maybe, the joint fails, either the aluminium or the solder crumbling to pieces; and then the experiments have to be begun again in the previous haphazard fashion.

By consulting almost any of the text-books a list of metals arranged in galvanic series can be drawn up or met with, and if the book be not too old the position of aluminium in relation to other metals suitable for the preparation of a low temperature solder can be studied. Unfortunately, the tables given by our authorities are generally based on the behaviour of metals when exposed to certain laboratory acids, alkalis, and salts, and not to the damp air or weak aqueous carbonic acid of everyday life. For this reason the data must be used with caution, as the series vary somewhat in order according to the nature of the electrolyte selected. Indeed, it seems possible that in this variation may be discovered one of the reasons—completely inevitable so far as it goes—for the occasional failure of aluminium, soldered or not, during exposure. Under oxidising influences aluminium closely resembles the metals of the alkalis and alkaline earths, being much less permanent than maganese, zinc, iron, &c.; under chlorinating influences aluminium resembles the last three metals, and is much more stable than sodium, calcium, and magnesium. Thus if any neighbour for aluminium be chosen to avoid galvanic action under the attack of, say, hydrochloric acid—for which purpose manganese and zinc are indicated—that neighbour will be too negative when oxygen is the corroding agent. And, *per contra*, such a metal as magnesium, which lies nearest to aluminium when oxygen is the enemy, is highly positive when chlorine appears on the scene. However, it will be found that, roughly speaking, and in this particular of galvanic action alone, zinc is the best metal of which to made a solder for aluminium; then lead, and finally tin. The best of all is, of course, aluminium itself; but to solder aluminium with aluminium is to "burn" the metal, in the language of the plumber, and that is different from what is understood as soft-soldering. Nevertheless, there is no objection, and, indeed, there is much advantage, in having a certain proportion of aluminium in the solder which is to be used with the bit.

Turning now to the problem of removing the film of oxide from the surface of the metal before soldering, we are met by the practical difficulty that the obvious agent, hydrochloric acid or something similar, is far from being perfect, or even satisfactory; for although it readily dissolves the alumina, before the solder can be applied the acid becomes neutralised by the excess of metal, the aluminium chloride seems to be ineffective in protecting the surface, and a fresh coating of oxide forms instantaneously. To meet this objection it is possible either to clean the metal mechanically underneath the layer of liquefied solder in the act of soldering, by filing, rubbing, or scratch-brushing and the like; or to incorporate into the solder some substance with is competent to decompose, remove, or dissolve the oxide. Methods for effecting this mechanically in the manner indicated, have frequently been suggested and patented; and we believe in skilful hands they all work more or less satisfactorily. A wire brush seems the most natural thing to use, but it is only available where the joint is on fairly stout metal and in an accessible situation. An idea for decomposing the oxide chemically has been patented lately by E. M. Totten, of Buffalo, and is being "boomed" considerably in the Press at the present moment. According to the published descriptions of this process, the solder consists of aluminium, 20 per cent.; tin, 30 per cent.; zinc, 40 per cent.; a "hydrocarbon," 2 per cent.; and 8 per cent. of some unmentioned constituent. The "hydrocarbon" is to be fat or wax (these are not hydrocarbons, but no matter), paraffin, &c.; and it is claimed to "increase the amount of carbon" contained in the solder, which carbon reduces the film of oxide (alumina) during the operation of soldering, and renders the scraping of the metal unnecessary. This claim is extremely interesting and instructive, because it has been known to students of electro-chemistry for many years, ever since the advent of the Cowles method of making aluminium bronze—and, indeed, before that time—that alumina cannot be reduced by carbon except at the temperature of the electric furnace; so that even if Mr. Totten's process actually does what it it represented to do, the carbon in the solder plays no chemical part in cleaning the metal.

As mentioned in a recent issue of the Electrical Review, Dr. Richards's solder for aluminium, which has just been discovered by several of our English papers, has

been in existence for eight years. It was patented in Great Britain under the name of W. A. Briggs on November 9th, 1892 (No. 20,208). The active ingredient for removing the oxide is phosphorus, and according to the specification, the solder is prepared by mixing 32 parts of tin with 1 of phosphor-tin containing 5 per cent. of phosphorus, then adding 1 part of aluminium, previously melted with 8 parts of zinc. It was also stated in the English patent that the melting point of the solder might be lowered by increasing the percentage of tin, while its mechanical strength could be improved by raising the proportion of aluminium and zinc. Further experience with the material has shown, however, that the normal composition, as given by the formula of the specification, tends to liquate when melted a second or third time; and so the solder is now composed of aluminium, 1 part; phosphor-tin, 1 part; zinc, 11 parts; and tin, 29 parts. It is used much in the usual way with a copper or nickel bit; but the aluminium requires to be first "tinned" (*i.e.*, coated with the solder as is done in soldering copper or sheet-iron), before the two pieces which have to be united are brought together. No flux is employed either on the bit or on the sheets, as the contained phosphorus effects the cleaning necessary. This solder has been adopted largely in America, and yields results probably as good as can be expected with aluminium; it has also been recommended by the authorities of the Neuhausen aluminium works. It is known to be permanent for over three years, to be as strong as, or stronger than, the aluminium itself, to be reasonably cheap, to have a colour matching well with the rest of the object, but to darken slightly after the lapse of time. As we remarked on a previous occasion, this solder was invented by Mr. J. Richards, of Philadelphia, although the name on the English specification is that of his son, Dr. J. W. Richards, of the Lehigh University, who is the chief American authority on all matters connected with aluminium. It is, therefore, hardly correct or courteous of one of our contemporaries to describe the latter in 1901 as "the latest aspirant for fame" as a solder maker, seeing that the material was patented in 1892, and the first edition of Richards's book, which contains everything known about the metal we are discussing (the ultimate source of our friends' information, in all probability) appeared in 1886.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

7,270. "The production of white lead by the electric arc." E. Bailey. April 9th.

7,284. "Improvements in pulleys for trolley heads, applicable to electric traction." J. Aspinwall. April 9th.

7,325. "Improvements in electric motors." W. P. Thompson. (C. D. Fuller, United States.) April 9th.

7,338. "Improvements in and relating to electric furnaces." C. P. E. Schneider. April 9th. (Complete.)

7,368. "Improved means for connecting electric wires and cables." A. Wilkes. April 10th.

7,397. "A new or improved process for the electrolytic production of caustic alkalies." A. Brochet and G. Ranson. April 10th.

7,439. "Electrically-controlled targets for use with rifles or other fire-arms." W. W. G. Webb. April 11th.

7,459. "Improvements in or relating to electric tramways or railways on the overhead system." E. Cervenka, J. Bernt and G. Meyer. April 11th.

7,462. "A new or improved apparatus for automatically charging accumulators." B. Klein. April 11th.

7,490. "Improved guard or structure for protecting overhead wires." W. B. Whittaker. April 11th.

7,492. "Improvement in winding for electro-magnetic inductive apparatus." H. H. Wait. (Date applied for under Patents, &c., Act, 1883, Section 103, January 12th, 1901, being date of application in United States.) April 11th. (Complete.)

7,497. "Improvements in contact boxes for the distribution of electricity." B. Cruvellier. (Date applied for under Patents, &c., Act, 1883, Section 103, November 21st, 1900, being date of application in France.) April 11th. (Complete.)

7,524. "Improvements in electric heating and in apparatus therefor." J. R. Quain. April 12th.

7,539. "Improvements in and connected with the electrical transmission of images, and in the recording of images." W. Friese-Greene. April 12th.

7,547. "Improvements relating to incandescence electric lamps." H. H. Lake. (C. D. Smithers, United States.) April 12th. (Complete.)

7,548. "Improvements relating to dynamo-electric machines." L. Maiche. April 12th.

7,553. "Improvements in electric alternate current motors." S. P. Thompson. April 12th.

7,557. "Improvements in electric cables." W. N. Stewart. April 12th.

7,558. "Improved means for insulating electric conductors." W. N. Stewart. April 12th.

7,565. "Improvements in and relating to systems of electric power transmission by overhead conductors." E. Rotter and T. H. Jones. April 12th.

7,576. "Improvements in electric signalling." A. T. M. Thomson and The Thomson-Davis Telephone System, Limited. April 12th. (Complete.)

7,584. "Improved method of obtaining electrical vibrations." F. T. Trouton. April 13th.

7,586. "Improvements in the apparatus for the separation of iron or steel filings, or the like, from brass, or other non-magnetic substances." B. Young. April 13th.

7,601. "Improvements in and relating to electric glow-lamp holders." C. E. Knowles. April 13th.

7,617. "Improvements in electric meters." C. O. Bastian and J. Vaughan-Sherrin. April 13th.

7,619. "Improvements in signalling on electric traction systems." E. Rotter and T. H. Jones. April 13th.

7,629. "Improvements in and relating to secondary batteries." I. Celestre and F. Condrand. April 13th. (Complete.)

7,641. "Improvements in and relating to telephone exchange systems." W. F. Smith. April 13th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

12,249. "Improvements in telephone systems and in apparatus therefor." A. T. M. Thomson and P. Warnford-Davis. Dated June 12th, 1899. Relates to a telephone system, in which the subscriber is provided with a printing-telegraph transmitter, by which he signals to the exchange the name or number of the exchange, and of the subscriber required. The exchange is provided with a special indicator, operated to one side or the other, according as to whether the subscriber wanted is on the same or another exchange. If the subscriber wanted is on the same exchange, a jack plug is inserted in the jack connected to the numerical printed. When the number has been registered, the plug is inserted in the jack of the subscriber wanted, and the exchange operator rings up both subscribers. If the subscriber wanted is on a different exchange, the name of that exchange is registered on the exchange printer, and the jack plug is then connected to that exchange, where the numerical printer is connected up, and the call is finally completed. The call transmitter or "latent switch" as it is termed, is arranged with a number of series of adjustable contacts, either to be contacted by a rectilinearly-moving contact spring, or by a rotating arm. Two forms of rotating arm transmitters are described—one with the contacts in a ring, and the other with contacts arranged as serrated cams. The subscribers' telephones are supported on brackets, provided with pivoted contact arms in place of the ordinary switch levers. The exchange and numerical printers are type-wheel printing instruments, with releasing dedents operated by the printing levers, and have returning springs for the type wheel. The plug sockets are pivoted so as to allow of two sets of springs, one set connected to the indicator, and the other set connected to the exchange printer. The special indicator is formed with a pivoted armature carrying two different labels, either of which may be exposed on receipt of a signal. The usual clearing-out signals are employed at the exchange, in one form small lamps being secured in the rear end of the plugs. 19 claims.

12,284. "Improvements in and connected with magneto generators." H. Oppenheimer. Dated June 13th, 1899. In a magneto generator for telephone calls, the pole-faces of the armature or field magnets, or both, are provided with one or more notches or slots, for the purpose of preventing induction in neighbouring lines when ringing-up. 1 claim.

12,353. "Improvements in or relating to conduits for electric conductors." F. Jones and F. A. Pocklington. Dated June 13th, 1899. Conduits are formed of lengths of partial section pipe closed by tile lids. The lids may be of various forms and fitting. The joints are either spigot and socket, or are butt joints with separate sleeves. The cables are supported on bridge-pieces, or on studs formed in the conduit lengths. The conduits are filled with insulating medium. Service and distribution fittings may be employed, as desired, the service box being divided by a vertical partition to separate the wires. A junction box, formed of earthenware, &c., may be fitted over the conduits, to form a chamber round the service, &c., fittings. The lid of the junction box is made of similar material to the surrounding paving. 5 claims.

12,420. "Improvements in wireless telegraphy." F. D. Braun. Dated June 14th, 1899. The transmitting and receiving planes for wireless telegraphy are formed of parallel wires either connected in parallel or in series, with preferably a metallic screen separating the alternate wires, *i.e.*, the front and back turns. Two sets of parallel wires may be connected in series, and an induction coil or spark gap may also be employed. The vertical rods connected by a resistance may also be employed, as well as two sets of parallel wires, the front set being at right angles to the back. 4 claims.

12,478. "Improvements in electrical accumulators or secondary batteries." O. Behrens. Dated June 18th, 1899. Relates to separators, and consists in making them of loofah, which preferably has been subjected to pressure. Powdered glass may be used to fill any spaces left in the battery when the plates and separators are in place. 3 claims.

12,506. "Improvements in and relating to automatic magnetic circuit breakers." H. H. Lake. (**W. M. Scott.**) Dated June 15th, 1899. Relates to resistance switches fitted with overflow cut-outs, and consists in arranging the coil or coils of the cut-outs so that it will not operate with an excess current, while the resistances are being cut-out. 5 claims.

12,565. "Improvements in connection with the windings of dynamo machines and induction motors." C. D. Abel. (**V. Karmin.**) Dated June 16th, 1899. Dynamos and motors, alternating current.—In order to obtain two different rotary phase current pressures from a drum or ring winding of the kind employed in continuous current machines, the said winding is cut open at a certain number of points, and the several sections of the windings thus formed are suitably connected together. 3 claims.

12,566. "Improvements in the arrangement and connections of the windings of dynamo machines." C. D. Abel. (**V. Karmin.**) Dated June 16th, 1899. Armatures.—Relates to the armature windings of dynamos for generating simultaneously continuous currents and rotary-phase currents, and for feeding a three-wire system with continuous currents without the use of a special equalising device. The armature carries at least two windings, which may be of the drum or wing type, one of which is a continuous current winding, connected to a commutator in the ordinary manner, while the other is a rotary-phase winding, divided up into six or a multiple of six sections, successive sections having a phase difference of 60°. When the rotary-phase winding is divided into a multiple of six sections, sections of the same phase are connected up in parallel. Each of these winding sections comprises $\frac{s}{6a}$ bars or coils, where s represents the total number of bars or coils, and $2a$ the number of parallel circuits in the windings, when regarded as continuous current windings. 1 claim.

12,627. "Improved manufacture of electric battery plates." Dr. E. Andreas. Dated June 16th, 1899. A plate or electrode is made by first subjecting a lead plate to pressure, so as to produce on each side a number of roof-shaped projections, and to leave a central stiffening piece. The projections are then cross-cut by a file-cutting or like machine, so as to produce the effect. The cuts may be oblique in direction. 2 claims.

12,668. "Improvements in earthed coverings or electrical tubular conductors." J. Y. Johnson. (Hartmann & Braun.) Dated June 17th 1899 Tubular conductors having an earthed outer casing have that casing formed of an open metal tube, with or without a bare wire attached thereto. The opening in the tube may be closed by a bent strip sprung in with a wedging action. The lengths are joined by metal sleeves, with or without an intermediate shoulder. Caps of tinfoil or other soft metal ensure good contact between the tube and sleeve. 4 claims.

12,730. "Improved galvanic cell." P. Offenbosieh and H. Rookel. Dated June 19th, 1899. Relates to a dry zinc-carbon battery. The carbon has packed around it a depolarising mixture consisting of a paste formed of ground carbon, brownstone, and Ceylon graphite. The depolariser is covered with linen and placed in the zinc electrode which is in the form of a tube, which is then filled up with, and covered on the exterior with, Iceland moss which serves as an absorbent for a strong solution of salammoniac. Outside this is placed a covering of vellum or parchment, and on the top of it is placed a layer of paraffin. The carbon electrode rests on a layer of goudron, which is tar boiled or evaporated to a density greater than that of ordinary tar. The electrodes are then placed in a receptacle which is half filled with gelatine. The upper part of the cell is filled up with goudron. Gas exits are provided. 4 claims.

12,731. "Improvements in electrical switches particularly suitable for high voltage connections." C. W. Holt and A. Atherley. Dated June 19th, 1899. Tumbler switches suitable for high voltages. The movable contact carried by the tumbler lever moves in a recess in the base and enters the fixed contacts from below. The contact is secured to the cheeks between which the snap spring may work. 2 claims.

12,750. "Improvements in or relating to electric railways and tramways on a road contact system." E. Cowenka and S. Mahler. Dated June 19th, 1899. Electric railways and tramways on a mechanically-operated road contact system. Conductors; switches. Two arms depending from the vehicle work in a slotted rail and successively act on the wheel which is connected by bevel and crank gearing to the plunger to raise and lower it as the vehicle passes. The plunger has a spring head connected electrically to the spring roller, which bears on a plate connected to the feeder when the plunger is raised into the path of a long collector. Casings enclose the parts. 5 claims.

12,767. "Improvements in and connected with coin-freed electricity meters." F. J. Beaumont. Dated June 19th, 1899. A coin-freed meter moves a switch to insert a resistance in circuit when the quantity paid for has been supplied, as described in Specification No. 17,523, A.D. 1897, but the resistance is now made variable inversely to the current being supplied, in order that the dimming of lamps may not vary with the number of lamps in circuit. For this purpose the current passes through a solenoid moving a core and lever in opposition to a spring; the lever either compresses a pile of carbon blocks or moves over the contacts of a divided resistance. This variable resistance is placed in circuit with the lamps through a contact and a projection on the switch, when the switch is leaving a main contact which ordinarily short-circuits the resistance. If current continues to be taken without payment, the projection leaves the contact opening the circuit. The switch may be moved by a connection with a sliding rod carrying a pinion which is operated in one direction by a worm turned by the coin mechanism, and in the other by a second worm turned by the measuring apparatus. 4 claims.

12,787. "Improvements in devices for breaking electric circuits and protecting the same from excessive currents." W. P. Thompson. (The Rolfe Electric Company.) Dated June 19th, 1899. Relates to cut-out devices for use in telephone, telegraph, and like low-tension circuits, so arranged that a considerable gap is made when the device operates, thus preventing arcing. In the arrangement, a plug completes the circuit between the contacts, and a spring tends to withdraw it to break the circuit. The plug is released by means of a device operated by an excess current. A resistance coil is embedded in a lump of wax secured to a bracket, and the coil has a loop which is fitted on a hook. In case of an excess current, the wire is heated and melts the wax. In a modified form, the plug is held in position by a fusible wire. In further modification, the plug is formed of two insulated conductors, and the springs are of different lengths. The contact-plugs are connected by a bridge piece which is held down against the springs by the loop fitting in a wax or like button. The lightning arrester comprises three carbon contacts coated with shella or the like, and fitted on a contact-plug so as to be removable. 10 claims.

12,788. "Method and means for increasing the conductivity of carbon to be used in electric cells and dynamo-electric generators and motors." C. W. Hertel. Dated June 19th, 1899. Relates to a method of increasing the electric conductivity of carbon. This is effected by placing a metal core, filling, or lining in cavities made in the carbon. The invention may be applied to battery electrodes, brushes for dynamo-electric generators and motors, contacts, especially contacts for switches and other articles. A carbon electrode for use in a Leclanché or like battery, has a number of cylindrical cavities which are lined with a a layer of perforated sheet copper. A conducting-strip is placed in each cavity, which is also packed with copper oxide or manganese dioxide. The electrolyte is preferably potash lye. The metal may also be in the form of a thin plate or plates, or wires, or rods. 6 claims.

12,789. "Improvements in telephone systems." R. Weinmar. Dated June 19th, 1899. Relates to the arrangements in telephone systems of registering mechanism for recording the number and duration of the conversations. One arrangement, in which are the registers of the two subscribers, the plug cords at the different board sections, the calling keys, and a three-way switch for cutting in and out the operator's instrument or the clearing out annunciator, and also for cutting the condenser in and out of circuit of the battery. The registering mechanism is only put into circuit when the connection is complete and the switch is thrown over to the left to cut out the operator's instrument. Various arrangements, providing one of the arms of the switch with electromagnetic devices are described by which a false registration is prevented, and which also, should the register make an incorrect record, correct the same. The arrangements are described as applicable to single and double wire systems, and also at exchanges with or without separate testing circuits. 10 claims.

12,842. "Improvements in electro-static measuring instruments." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated June 20th, 1899. Electro-meters.—The movable plate of an electro-meter is arranged so that, as it is attracted to the fixed plate, the distance between the opposed surfaces diminishes. The plates are parts of cylinders and the movable plate is carried on an axle by a metal disc. The fixed plate is supported eccentrically to the axle. The axle is carried between bearings on a yoke and its rotation is opposed by a spiral spring attached to the yoke. It carries a pointer near a fixed scale. The disc moves between the poles of a magnet, to damp the vibrations of the movable part. Any electro-meter for use with very high pressures is mounted in a glass vessel in which the highest possible vacuum is produced, to prevent discharge from occurring. The fixed plate and the yoke are carried by long stems in extensions of a bulb, connecting wires being sealed through the ends. The extension of the tube may be bent downward to dip in oil vessels, in which the connections are made. The scale is etched on the bulb. In a modified arrangement the metal parts of the instrument are all mounted on one vertical stem in the bulb which is supported on a glass foot. An electro-meter with flat quadrants may be so mounted. 9 claims.

12,883. "A method of and apparatus for repairing incandescent electric lamps." M. Dumont. (Dated June 20th, 1899. (Date under International Convention, April 12th, 1899.) Incandescent lamps, inserting new filaments. The lamp is unsealed by a rotary disc applied to cut into the sealing point, the lamp being laid on its side by a cushion carried by a horizontal plate, clamped adjustably on a horizontal support, above which the cutter is carried by a horizontal shaft on a slider movable vertically by a counter-weighted hand lever. A larger opening is made before a blow pipe. The old filament is cut off, leaving short ends, by applying a conducting-rod to form a small arc to the filament, which is removed. The bulb is then filled with a liquid hydrocarbon and a new filament placed in it, in a box in the filament-fixing apparatus, the lamp is placed on a ball-jointed socket, and the filament on a hook carried by a spring clip on a vertically sliding and universally jointed support. One end of the filament is then held and applied to the left end on the leading-in wire, while electric current is supplied through this and the holding tool to effect a deposit of carbon on the junction. After the other end has been fixed similarly, a conductor carrying a platinum wire is substituted for the hook, and applied to cause further deposit of carbon on the junctions. The lamp is then inverted on a drainer, and afterwards sealed and exhausted. The filament-holding tool consists of a grooved nozzle rotatable on a joint piece, pivoted on a sliding tube which is provided with a spring valve to connect it with exhausting apparatus, to hold the filament in the groove in the nozzle. The tool is hung by a spring socket from a flexible electric conductor passing over pulleys to a counterweight. Current is supplied to the clip-support or the tool from a two-way switch, a circuit-closing pedal and a rheostat. This consists of fixed and movable carbon plates in a liquid, the movable plate being carried by a vertical pulley shaft, rotatable in one direction by a cord and weight and in the other by a cord and pedal. Liquid hydro-carbon may be supplied from a closed vessel by a jointed tube, a valve and a perforated nozzle; air is supplied to the vessel from an inner tube projecting from the nozzle and provided with a sliding stopper. In a modification the new filament is attached to short wires, wire spirals or tubes, and these are applied by forceps with serrated jaws and electrically-welded or fused to the original leading-in wires. 5 claims.

12,949. "Improvements in or relating to the connection of house service or branch conductors to electric mains." L. Andrews and J. Glass. Dated June 21st, 1899. Couplings for connecting branches to concentric mains. The conductors are exposed. The inner conductors are soldered together and covered with insulating material, such as tape or a divided T-piece. A divided metal T-piece is placed over the piece and the conductors soldered to it. This connection is covered with insulating material, and the conductors connected by a similar T-piece which is covered with insulating material. The joint is then preferably enclosed in a T-shaped box. In the modified arrangement the junction pieces are formed with openings through which insulating material may be poured to fill up the spaces. With double cables the intermediate connection is dispensed with. 3 claims.

12,951. "Improved cut-out apparatus for automatically disconnecting incandescence lamps having filaments of secondary conductivity." W. P. Thompson. (The Vereinegte Electricitats Actien Gesellschaft.) Dated June 21st, 1899. Incandescence lamps having heaters for the filaments are provided with slowly acting cut-outs which operate to cut out the heaters should the filament be destroyed. Comprises filament, a heater, a magnetic cut-out for cutting out the heater directly the filament becomes a conductor, and a second cut-out. A fusible wire in the circuit is passed through a tube surrounded by a heating coil. After a certain period of heating the wire melts and breaks the circuit. The fusible wire may be stretched by a spring. Instead of a fusible wire, two conductors connected by fusible metal may be employed. In a further modification, the tube is perforated to allow air currents to pass through to cool the wire, so that it will not fuse readily. In a modification the lever is moved to break contact by the expansion of air within a vessel having a flexible top. The air is heated by means of a coil. In this form, contact is again made when the air cools. 5 claims.

12,956. "Improvements in electric furnaces." La Compagnie Electro-Metallurgique des Procedes Gin et Leleux. Dated June 21st, 1899. (Date under International Convention, January 27th, 1899.) A furnace applicable for making calcium carbide consists of a movable carriage supporting a conducting-hearth within a perforated metal casing placed below a vertically movable electrode, and near perforated walls through which a draught passes to a flue and chimney. The air drawn in near the electrode cools it, and the furnace gases are burnt, keeping the walls hot. The electrode consists of four rectangular blocks of carbon of high conductivity, surrounded by a baked mixture of carbon and oil tar which renders the outside of the electrode less conductive, to keep it cool, and prevent combustion in the air. The electrode is supported by four copper plates which extend down between the upper ends of the blocks, and are clamped against silvered copper plates thereon by bolts, wedges, screws, and nuts. The plates are attached to a head which is hung by a chain and pulleys on an overhead support, and is connected by flexible cables with stationary conductors. The bed of the furnace consists of carbons partly separated by concrete to keep the hearth hot near the outlet. The bed rests on a cable laid on a copper plate on the carriage, which is insulated from its wheels, and has a projecting block to enter between laminated brushes on stationary conductors when the carriage is moved into place. 6 claims.

12,962. "Improvements in electrically-propelled motor vehicles." P. W. Florthey and The Electric Motor Power Company, Limited. Dated June 22nd, 1899. Relates to electrically-propelled carriages, and comprises the arrangement or disposition of the motor and cells and the construction of the transmission gear. The motor is preferably of the multipolar ring magnet type, and as applied to a brougham, is disposed centrally as regards the width of the vehicle with the shaft slightly inclined. The cell boxes are placed below, enclosing the inclined shaft. The motor is connected with the driving axle by means of a double universal joint provided with a telescopic connection to a worm on tangent gearing and differential gear. As applied to a dog cart, the motor is placed vertically, and acts on the worm shaft, which is placed horizontally through the medium of bevel gear. 3 claims.

13,008. "Improved apparatus for converting alternating currents into continuous currents." M. Dori. Dated June 22nd, 1899. Relates to apparatus for converting alternating, simple or polyphase currents into continuous currents. The apparatus has fixed magnets and coils, and the continuous current is taken from fixed points, but short circuiting brushes rotating synchronously with the magnetic field connect the windings. The brushes are carried by a synchronous motor or by a rotor forming part of the apparatus. The continuous current is taken off from fixed points of the transformers employed for producing the rotary field in the core having windings. The synchronously rotating brushes are arranged to make connection with the points of the highest and lowest potential. Numerous arrangements of the connections are described in the specification. In one arrangement the continuous current mains are connected to fixed points on the magnet windings. The motor can be utilised for producing ventilation for cooling the apparatus. 5 claims.

13,018. "Improvements in electric arc lamps." J. B. Barton and J. M. Gorham. Dated June 22nd, 1899. Arc lamps. To steady the arc when it is starting, the movable carbon-holding tube of a lamp is connected with a pivoted support for a rolling or sliding weight which tends to keep the carbon in contact at starting, but subsequently moves to the outer end of the support, so that the carbon is relieved of the extra weight. The tilting support may be a closed tube or tubes, or an open frame pivoted at one side of the frame of the lamp. The tilting frame may be provided with a depression, so that in its outer position the rolling weight rests below the pivot; or the frame may be extended so that the weight moves beyond the pivot. The rolling weight may be a ball or cylinder. The provisional specification mentions the use of springs instead of weights. 6 claims.

13,054. "Improvements in holders for globes and shades of gas, electric, and other lamps." C. F. Sanders. Dated June 23rd, 1899. Relates to improvements on the invention described in Specification No. 8,343, A.D. 1894. The neck of the globe or shade is held by two fixed projections and a movable projection, which is actuated by a slide This slide is guided upon the gallery by the engagement at one end of the slot with a pin on the gallery, and at the other end of the piece with the raised portion of the gallery, and is formed with a curved slot which engages with a stud on the projection. The projection is thus actuated by moving the slide by means of the thumb-piece against the action of the spring, which normally holds the slide in such a position that the projection is extended. The spring may be dispensed with, and a pivoted projection may be employed. 2 claims.

13,118. "Improvements in mechanism for electrically driving Roots' and like blowers." A. D. Ellis and W. B. Crichton. Dated June 24th, 1899. Driving blowers. Roots' and similar blowers are coupled to electro-motors and driven by means of gearing. The motor shaft is directly connected to a shaft on which are right and left hand worms, which drive worm wheels on the vane wheel shafts. The shaft is fitted with adjustable bushes for taking up end wear, and with an end bush to receive end thrust. 1 claim.